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Male Red-winged Blackbird (*Agelaius phoeniceus*) engaged in "song-spread" display. Photographed by Robert W. Nero, near Madison, Wisconsin, on May 15, 1955.

A BEHAVIOR STUDY OF THE RED-WINGED BLACKBIRD[1]

I. Mating and Nesting Activities

BY ROBERT W. NERO

THIS study is concerned with the behavior of the Red-winged Blackbird or "Redwing" (*Agelaius phoeniceus*) on a breeding ground near Madison, Wisconsin, during the years 1948 through 1953. Part I describes the behavior related to pair formation, courtship and mating activities. The formation, maintenance, size, and structure of the male territory, female territorial behavior, and behavior of first-year (immature) males will be described in a subsequent issue of this journal. The study is a continuation and expansion of a more general study of this species initiated in the same area by James R. Beer in 1945 (Beer and Tibbitts, 1950) and is part of a thesis submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Zoology at the University of Wisconsin (one aspect published previously: Nero and Emlen, 1951).

Grateful acknowledgment is tendered Professor John T. Emlen, Jr., who offered advice and guidance throughout the study. Thanks are due the following persons for aid in various ways: Professors Robert A. McCabe and Joseph J. Hickey; Drs. James R. Beer, Ernst Mayr, Nicholas E. Collias, Ruth L. Hine, Howard Young, Arnold Bakken, Arnold Petersen, Robert L. Strecker, Fred A. Ryser, Frederick Greeley; Mr. Jack Kaspar, Mrs. L. S. Miller, and Miss Margaret Grismer. I wish to give special thanks to my wife, Ruth F. Nero, for her constant support during the years of graduate study. This study was aided by a Louis Agassiz Fuertes Research Grant awarded by the Wilson Ornithological Club in 1952.

Methods

The main study area was a 2.4-acre cattail (*Typha*) marsh on the east shore of Lake Wingra in the University of Wisconsin Arboretum at Madison. This marsh is bordered by red osier dogwood and willow, and is surrounded on three sides by a fairly dense stand of mixed hardwoods. Observations were also made at a feeding and flocking area in Vilas Park Zoo, about one-half mile north of the marsh. Additional records were obtained wherever Redwings were encountered.

Field notes were recorded on 358 days during six breeding seasons, from 1948 through 1953. (Supplementary notes were made in 1954 and 1955.) Observations began each year with the arrival of the first resident males in March and continued until August or September when resident birds (marked) left the area. Most of the photographs were taken by the author

[1]Journal Paper No. 32, University of Wisconsin Arboretum.

in April and May, 1955, on several marshes within eight miles of Madison. The photos in Figure 3, however, were taken in July, 1955, in Saskatchewan, Canada, with the aid of Mr. Fred W. Lahrman.

Trapping of adults and immatures was accomplished by means of wire-mesh, treadle-sprung traps baited with white bread. These traps were placed on top of muskrat houses and floating boards, and on top of wire screens which were pressed onto old, standing cattails. Several females were captured by placing a screen-bottomed trap directly on top of the nest when the female had a full set of eggs or young. Individual identification was obtained by the use of combinations of colored plastic "leg" bands. A drop of Duco cement applied within the plastic coil secured the band. From 1948 through 1952, 282 birds were so marked, 175 of these being juveniles. Observations were made with the aid of binoculars from several vantage points within the area as well as along the edge. In 1949 observations were greatly aided by watching from a board fastened between two trees on the edge of the marsh, about 12 feet above the water. This worked so well that in 1950 two towers 12 feet high were erected in the marsh. These elevated platforms permitted close observation of behavior ordinarily concealed by the vegetation.

The Birds

Size of population.—The number of adult males holding territories on the study area during the height of the season (middle of April to middle of June) ranged from about 17 to 25 during the years 1948 through 1953. The number of females with nests during the same period ran from 27 to 50.

Dates of arrival and last appearance.—From 1949 to 1953 previously-resident males (8 to 13 marked males each year) first appeared between March 6 (1950) and March 17 (1952) (average, March 10–11). The last ones to arrive appeared between March 22 (1953) and April 21 (1949). The minimum period for arrival of all the marked residents was 9 days (1953, 9 birds); the maximum, 43 days (1950, 13 birds). The average arrival period was 29.2 days. Certain males were consistently early arrivals, others consistently late. First arrival dates for individuals varied in consecutive years over a period of up to 20 days (average, 13.6 days). Previously-resident females arrived first on April 8 (1952), April 16 (1951), and April 17 (1950). Information on dates of last arrivals of females is available only for 1951, in which year the last marked bird appeared May 7. This gives a period for arrival of females that year of 21 days.

Very few marked birds were seen on the marsh in August, but some were seen on the feeding grounds at Vilas Park during this month. In 1948 a resident female and her young were still on the marsh on August 4;

they appeared to be the last birds present. On August 15 of the same year a marked adult male was seen at the park. A banded young was seen on the marsh on August 6, 1949. Evidence that at least some of the local residents do not migrate until later was obtained in 1951 when two marked adult males were seen on October 22 and 23, respectively, three miles from the breeding marsh. Each male was with a flock of about 50 males.

Annual returns.—Fifty-six per cent of 50 marked adult resident males returned at least once during the period from 1947 to 1953. Each season, from 10 to 22 adult males were present (see Table 1). Marked resident females showed a similar rate of return. Of 48 birds, 56.2 per cent returned at least once during the seasons 1949 to 1953. Table 1 shows the survival of each year's marked population. Of 16 different males, 10 survived five years, three survived six years, and three survived seven years. (Note: two 8 year olds returned in 1954 and a 9 year old bird returned in 1955.) Two females survived at least six years. Some of these birds were banded as adults and may have been older. Davis (1953) reports a life span of 15 years in captivity for the Cuban Redwing, *A. p. assimilis.*

Polygyny.—Polygyny in the Redwing has been recorded by several authors (Allen, 1914:92; Roberts, 1932:306; Linsdale, 1938:140–141; Mayr, 1941:83), although a few observers have reported this species to be

TABLE 1

YEARLY RETURN OF MARKED RESIDENT REDWINGS

The top number in each vertical column is the number of new residents marked that year. Reading down each column one sees the subsequent return of each year's population.

Males

Year	1947	1948	1949	1950	1951	1952	1953	Total Population
1947	11							11
1948	7	10						17
1949	5	5	12					22
1950	2	3	8	7				20
1951	2	2	5	5	7			21
1952	1	1	1	2	3	4		12
1953	0	0	1	2	3	4	0	10

Females

Year	1949	1950	1951	1952	1953	Total Population
1949	15					15
1950	12	32				44
1951	5	14	2			21
1952	2	9	0	0		11
1953	0	9	0	0	0	9

monogamous (Williams, 1940:268; McIlhenny, 1940:85). Redwing matings in this study were occasionally monogamous but were mainly polygynous. Of 25 males for which accurate records were kept, five had one mate each, 16 had two mates each, and four had three mates each. I have no record of a male breeding successfully with more than three females. However, in at least one case where a male had three mates, one female returned for a second nesting, so that four broods were brought off in this territory. Linsdale (*loc. cit.*) working with unmarked birds in Nevada, reported that one male ". . . would have as many as 6 females all actively nesting."

According to Linsdale (*loc. cit.*), "The success of a male in obtaining females in its territory seemed to depend almost entirely upon the suitability of the habitat for nest locations." My females showed a preference for nesting on the edges of the openings within the dense cattail stands. Since not all territories had an equal amount of edge, some might have been more suitable for nesting than others. Linford (1935:37) found that the territories of polygynous Redwing males were twice the size of those of monogamous males, but I found no relationship between territory size and the number of nesting females. In Linford's study, however, the birds obtained the bulk of their food within their territories, whereas my birds obtained most of their food outside their territories.

Allen (1934:136) considered that the male Redwing was not "agreeable" to polygamy because of the great difficulty of running two or three double families each season. He suggested that a male was "satisfied" with one female. However, the males in my study played little part in feeding the young and only a very few birds (three) had more than one brood. Female intolerance of other females may play a large part in limiting the number of females breeding in one territory; a male is rarely able to successfully "court" two females at exactly the same time. Nesting data tend to support this — in most, but not all, cases females within a single male's territory are "out of phase" with each other (see Table 2).

Second nesting.—As Beer and Tibbitts suggested (1950:73) double broods are uncommon in the Redwing in this area. Only three cases of double broods were recorded in this study (in 1949, all successful). In 1950, the year for which the most data are available, 20 marked females had successful first nests, but none of these females returned to the marsh for a second brood. In each case in which females had second broods, they bred with their original mates. A female which arrived on April 17 had fledged young on June 8, and nine days later she had her first egg in her second nest. Another female which left with her young on June 15, returned on June 28 and had her first egg on July 4, seven days later. A third female was feeding her fledged young until June 27 and on June 28 had her first

TABLE 2

NESTING STAGES OF FEMALE HAREM MATES IN SEVEN MALE TERRITORIES ON JUNE 7, 1950

Territory	Female 1	Female 2	Days apart
A	young at 2 days	young at 3 days	1
B	3 eggs	young at 6 days	6
C	3 eggs	young at 5 days	25
D	2 eggs, young at 1 day	young at 4 days	3
E	4 eggs	young at 3 days	12
F	3 eggs	young at 7 days	7
G	4 eggs	2 eggs, young at 2 days	2

egg in her second nest. In two of the above cases the pairs were never separated, the females remaining on or near the territory while feeding the young.

PROMINENT DISPLAYS AND POSTURES

The behavioral characteristics described below include sexual, aggressive, and social posturings. Other sequential displays which are neither as well-defined nor elaborate are discussed under various sections (see Courtship and Copulation). Vocalizations are not completely covered in this study.

Exposed epaulets.—Exposure of the patch of red feathers on the male's wing is a generalized display seen on many occasions, usually in conjunction with other postures or movements. At higher levels of intensity the red coverts may be erected and even vibrated, thus greatly increasing their area and color effect. When a hawk is overhead, when a male trespasses on another territory or is being dominated, or when a male is feeding together with other males on the ground, the red coverts are kept concealed.

Male song-spread.—"Song-spread" designates the behavior of the Redwing during the delivery of the well-known "oak-a-lee" song. Variations of the male display may be seen in Figure 1 (*a*, *b*, *c*, *g*, *h*, *i*). Usually the head is lifted or thrust forward, the tail is spread and lowered, the wings are spread, and the epaulets are raised (see Figure 1*g*, *h*). The head is thrust out with the first note of the song; at the climax, the drawn-out "lee," the tail and wing feathers are carried to the extreme position. The closure of song usually marks the return to normal position, but often the spread display is held for some time afterwards. The extent of song-spread, and other displays, varies with the level of motivation. In extreme or "complete" displays the wing-tips touch the outer tips of the tail, the bird sometimes assuming an almost disk-like form (Fig. 1*h*, *i*). The last phrase of the song is similarly given with varying emphasis. According to Allen (1914: 89) the song ". . . is always accompanied by spreading of the wings and tail feathers and by erection of practically all the body feathers, especially

those of the shoulder patches." However, this song is sometimes given with little plumage display (Fig. 1*a*).

Song-spread is given commonly on the territory but it is also frequently given off the territory and before and after the breeding season, though generally without the postural components. Migrating Redwings are in constant song, especially on the roosting grounds. Although song is often given by solitary males, it is given with a greater frequency and extent in the presence of other males. It appears most extensive when directed toward a particular individual. Song is most frequently given while the male is perched but it is also given while in flight. It may at all times, however, be readily distinguished from the "flight-song" described below. Song-spread is given on the territory long before the females arrive, and although it may be given more frequently and extensively in the presence of a female, it appears to be directed mainly toward other males. The presence of a female seems simply to elicit a greater amount of "warning" song.

Female song-spread.—A song-spread display resembling that of the male is commonly given by females (note comparable postures in Figure 1). As in the male, the degree of posturing changes with the intensity of the display. In the "complete" display the bird stands upright, with head raised, tail spread and lowered, with the red-tinged epaulets sometimes erected. The female song, although given with considerable variation, is generally a series of high, shrill and rapid notes, slowing and descending at the end, the last phrase often very sibilant and slurred. It may be rendered "spit-a-chew-chew-chew . . ." or "check-check-a-skew-skew-skew. . ." A more halting and labored call "pee-chee-ta-chee-ta-chee-chee-chee . . ." often leads into the former call and seems to be a more general excitement or alarm call. Song-spread of the female usually is given to other females from prominent positions within her area. Often most of the females present on the marsh may be shrilling or screeching in song-spread to a single female circling overhead. In early May these calls sometimes seem to be the main sound on the marsh, almost eclipsing the songs of the males. Female song-spread has been heard on the study area as early as April 8 (1952), one day after the first females had made their appearance.

Male flight-song.—"Flight-song" is a display given by males which often serves to distinguish territorial birds, although it is given less frequently than song-spread. The full call, always given in flight, is a long, rapid series of notes something like: "tseeee . . . tch-tch-tch-tch . . . chee-chee-chee-chee . . .", (the middle phrase often very nasal in tone, sometimes

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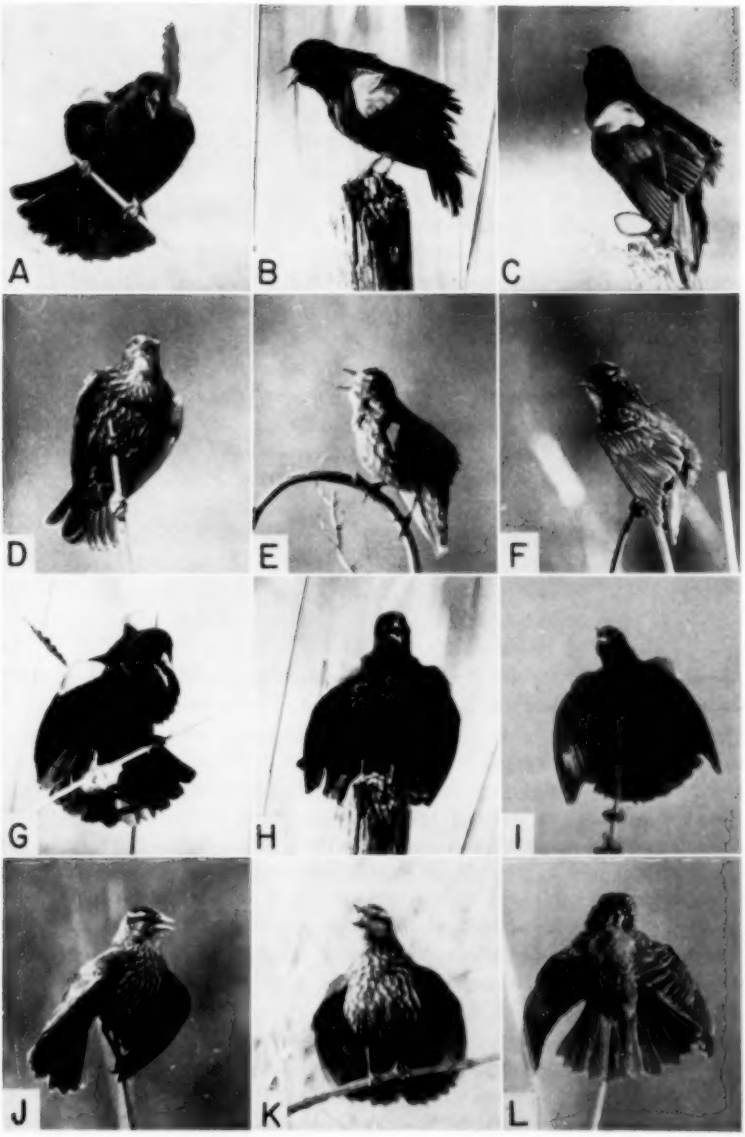
FIG. 1 (opposite page) Song-spread display, male and female. All photos taken at height of display, and the figures are arranged to show increasing intensity of display. Note comparable postures of the two sexes.


A
B
C
D
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L

"tank"). Sometimes only a portion of the call is given, and often the number of notes in each phrase varies, but the call is very distinctive.

What is apparently the same display is mentioned by Allen (1914:90): ". . . a sort of scolding song, which is given in the air, with quivering wings, can easily be resolved into: *check, check, check, t'tsheah.*" The "flight song" described by Beer and Tibbitts (1950:67) may be the same thing: "The victory display or flight song . . . is normally given after successfully chasing a trespassing male from the territory. After the chase has been completed the male slows his wingbeat, spreads his tail and 'parachutes' back to his singing perch. During this display he is in continuous song." I have only occasionally observed this display as an aftermath of an aggressive chase. It is regularly given when leaving or returning to the territory, the return flight often being a long, slow glide.

A rapid call which resembles the middle phrase of the flight-song ("tch-tch-tch . . .") is frequently given during sexual chasing, where it appears to be a scolding or vocal threatening. A similar call was heard on other occasions also suggesting an aggressive motivation. For example, on May 21, 1950, a male gave it repeatedly while chasing a Kingbird (*Tyrannus tyrannus*).

Bill-tilting.—Beer and Tibbitts (1950:67) described a posture assumed by males in mutual threat on their territory boundaries which they called the "bluff" or "stretch display." A closely similar display has been observed in several other icterids. For example, Williams (1952:8) called a probably-related display in the Brewer's Blackbird (*Euphagus cyanocephalus*) the "head-up display." Since the most constant characteristic of this display in the Redwing appears to be the raised beak, I have called it "bill-tilting." Prominent aspects of this pose are the stretched neck with raised beak and compressed body plumage (see Figure 2*a*, *b*). Although the epaulets are exposed in this display, they are never erected. Bill-tilting is most commonly given by adult males on their territory boundaries, each moving up, when suitable perches are being used, as if one bird were attempting to avoid the other without giving ground. On one occasion when two males were tilting to each other in a tree, the uppermost bird moved *down* and even hung down to display to the lower bird as the latter moved up. It is also given by females (Fig. 2*c*), immatures and young. It is mainly an intraspecific display, but both males and females have been observed to give it when confronting other species of birds. Females commonly used it in threat to other females (Fig. 2*d*), occasionally to first-year males, and rarely to adult males. Juveniles used it mainly against first-year males. On several occasions aggressive action was observed immediately following bill-tilting.

Male crouch.—The "crouch" is a tense crouching posture assumed by the

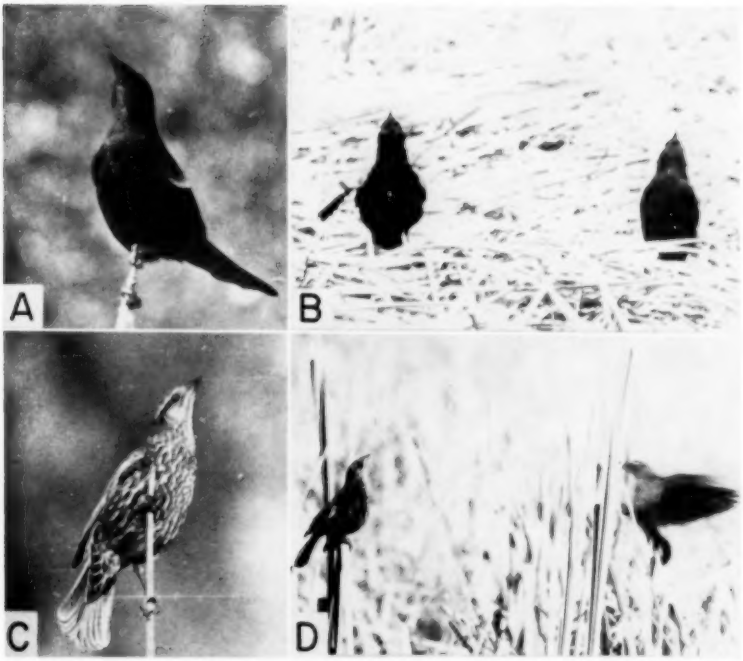


FIG. 2. Bill-tilting display, male and female.

male while perched (see Figure 4*a*). The body is depressed, the head is hunched and held low, the tail is spread and brought downward, and the "shoulders" are held out from the body with the epaulets erected. The wing tips may be crossed over the back or dropped close to the sides. Rarely, the spread tail is momentarily raised. (Males also occasionally held their tails nearly straight up in evident alarm, but nothing comparable to the "elevated tail display" described by Williams (1952:7–8) in the Brewer's Blackbird was seen in the Redwing. Flocks of Redwing males feeding on the ground often keep their tails lifted, a gesture not at all understood.) The crouch posture often is assumed by the male when near one of his mates, usually while facing her, and often preceding further sexual activity. It is also given before new females and before dummy females, but it has not been seen otherwise. Apparently it is an indication of sexual interest.

Female wing-flipping.—During the period of "feeding-the-young" the female frequently raises and flips one or both wings when her mate is

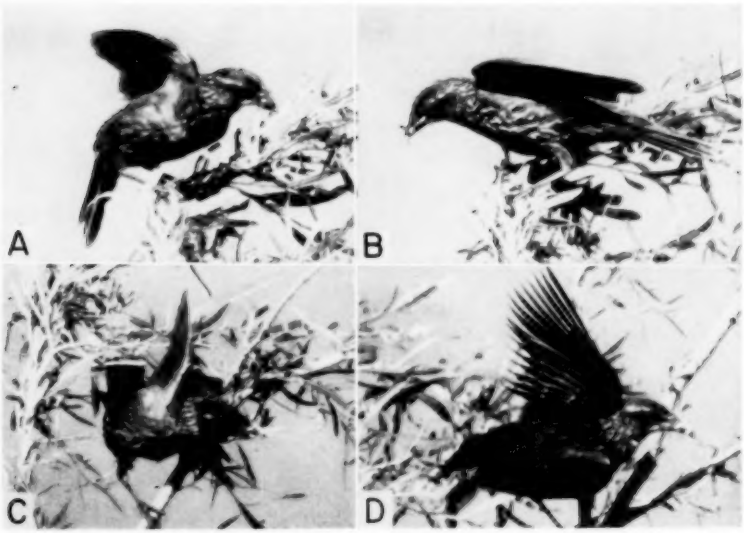


FIG. 3. Female wing-flipping display.

nearby. Such "wing-flipping" involves movement of the whole wing at body level, and, at high intensity, nearly vertically (see Figure 3). In some cases the wing on the side toward the male was held highest. This behavior is apparently not accompanied by any vocalization, but in two cases females held their beaks open. In one instance a female repeatedly bowed "as if to touch her beak to water to drink" and increased her wing-flipping (higher and faster) as her mate approached. Finally the male dived at her aggressively.

Wing-flipping was observed to be given as much as 10 feet from the nest, although it was usually seen at a lesser distance. It was given especially just after a return to the territory with food for the young, and shortly before departure for more food. In one case a female flipped her wings before feeding her young and then kept them raised while actually feeding them. In all of 20 detailed observations of wing-flipping recorded between June 7 and July 16 (1950) the females had young in their nests ranging from one to eleven days old. The mate was always nearby when the female wing-flipped. On a few occasions both male and female have been observed to give a kind of wing-flipping when leading young off the marsh.

One female, whose nest had been transported experimentally into a strange territory, upon being attacked at her nest site by the resident male, raised

a wing on the side away from the male as if in defense. At this time she had eggs in her nest. This is the only instance in which a female with eggs raised a wing to a male. Two days later when the eggs had hatched she raised and flipped both wings to the same male. At the Vilas Park feeding grounds several observations were recorded of females lowering a wing to the ground when being approached aggressively by adult males. The latter usually appear antagonistic to strange females on the feeding grounds. In one case when a female was threatened by an adult male she raised and fluttered her wings at her sides in the manner of a young bird begging for food. The above actions by females appeared to be defensive reactions. According to Nice (1937:57), male Song Sparrows (*Melospiza melodia*) attempting to invade a territory often held one wing straight up in the air and fluttered it as they faced the defending resident male. In one unusual case when a female (which sometimes drive off trespassing males) faced a trespassing male she was ". . . all puffed out and *flipping a wing* . . ." at the male (Nice, 1943:187).

A unique observation was made on an unmarked pair of birds on June 22, 1950, at a lake 30 miles from the study area. A male was seen approaching a female which was perched near a nest. The female began slowly flipping both wings quite high and then, apparently coincident with signs of sexual excitement in the male, she lowered her wings, fluttered them more rapidly and went directly into precopulation display (see Figure 4*h*), quivering her wings and raising her tail slightly. The male soon dropped his excitement postures, but the female maintained hers for a few seconds later.

These observations under normal conditions were supplemented by observations in Saskatchewan in 1955 during an experimental attempt to elicit wing-flipping behavior for photographic coverage (see Figure 3). On July 16 five newly-fledged young were placed in a small cage which was set about 12 feet from the camera. For 1½ hours the female attempted unsuccessfully to feed her young, meanwhile giving extensive wing-flipping before the thoroughly-alarmed male. The female frequently raised both wings, often holding the one of the side toward the male higher, and rapidly reversing wings when she changed position. Much of this sequence was suggestive of the behavior of fledglings begging for food (see Nice, 1950:89). The female continued to show wing-flipping as she searched for food as much as 50 feet from the young and the male, but her wings were held highest when the male was near. Sometimes one wing would be raised over her back and tilted over the opposite side (see Figure 3*c*, *d*). When her wings were held up and shaking, her posture resembled the "elevated wings" of the courting male (Figure 4*c*). In extreme display her wings were raised over her back until they touched and were then directed toward the male, some-

times by tilting or bowing. The male seemed to show some aggression to the female at this point and once raised his wings while pecking toward his displaying mate.

Wing-flipping by the female seems to be an indication of her concern with "feeding-the-young." Just as the male simulates female nest-building behavior during courtship (see Symbolic Nesting) and in moments of anxiety during that stage of their cycle, so the female simulates the behavior of hungry young.

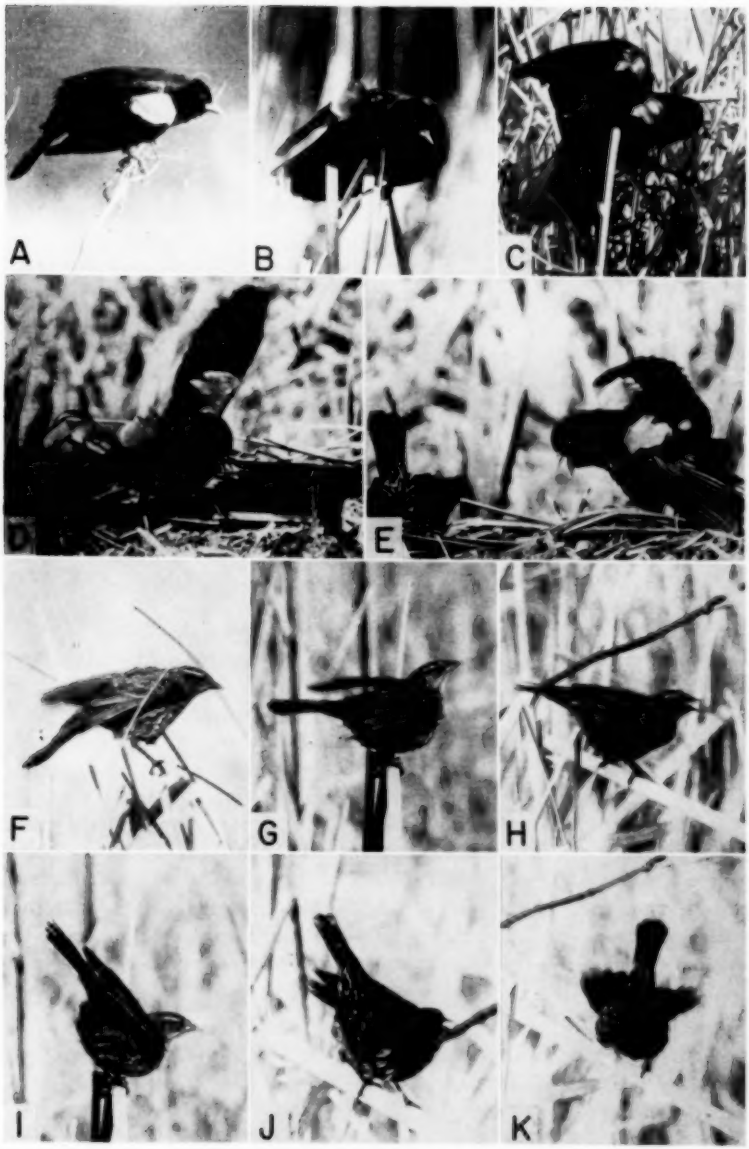
The Pairing Bond

In the Redwing, as in the majority of passerines, the sexes form a bond for the breeding period only. In many species the members of the pair remain together until the young are self-sufficient, but Redwings appear to separate as soon as the female leaves the territory with the young. This must be the case when the male remains on his territory with his other females, but even monogamous pairs apparently separate. Individuals of either sex have been observed caring for young off the territorial grounds, but I have never observed a marked pair together caring for their young off of the male's territory, or at least very far from it. The pairing bond evidently lasts only while the pair is attached to the territory. I made many unsuccessful attempts to observe breeding pairs feeding together outside their territory. Mated pairs only infrequently left the marsh together to feed (the male usually returning first), although males often left in small groups and these birds sometimes fed close together.

In the Redwing the pairing bond does not appear to carry over from season to season as it does in the Brewer's Blackbird (Williams, 1952:9–11). Several of my returning females remated with their former mates but others mated with other males even though their previous mates were present. Nevertheless, females which reassociated with former mates seemed to establish themselves with less effort than did those which acquired new mates.

In Redwings it is well-known that the sexes tend to remain separate throughout the non-breeding season. Males revert to flocking behavior as soon as they quit their territories. My marked males were often seen associating together with other adult males on the Vilas Park feeding grounds in late July and August. In one unusual case a male cared for two of his young until they were 36 days old; during the last nine days of this period he was observed on the feeding grounds in loose association with a flock of males. Females also flock together at this time and move to the uplands with the majority of the young.

Fig. 4. (opposite page) Sexual displays, male and female. Figs. *a-c*: male "courtship"; *d-e*: male precopulation; *f-k*: female precopulation, showing increasing intensity.


A
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Arrival and Establishment of Females

Arriving females are generally fairly quiet and may only give soft "check" or "prit" calls. Single birds or small groups circle in the air over the marsh, or perch nearby and sit quietly or give frequent tail flips until approached by males. Usually the appearance of a new female alerts the males within several hundred feet and various short calls, such as a "check" or soft "ticka-ticka" or shrill "tseee" are given. Some males may sing and fly down to their respective territories; some may stay up on their perches; others may fly up and perch near a female. If a female remains up in a tree, then the males, perhaps several of them, fly up and perch near her, slowly hop along the branches toward her (usually with erect epaulets), and then fly down with song-spread to their territories. Often the females flee at the approach of the males; the latter sometimes fly after them for several hundred feet before returning to their territories. Sometimes these females circle the marsh before flying away and occasionally they suddenly dive into the cattails.

When a female lands in the cattails all the males nearby usually move up to their borders nearest the female and perform a song-spread broadly (Fig. 1*g*, *h*, *i*). The holder of the territory on which the female lands often approaches to within a few feet of her to do this and then displays for several seconds after the cessation of song (Fig. 4*b*). This "after-song" pose is sometimes accompanied by a soft-whimpering "ti-ti-ti-ti-. . ." On some occasions males held their wings spread before they sang. At this time there may be comparatively little song from the holder of the territory. If the female approaches the male he sometimes drops down to the base of the cattails, often down onto the early spring ice, and struts around with wings extended laterally, sometimes rapidly vibrating them, while giving the call mentioned above. Sometimes the extended wings may be partly raised. This display was also given immediately after song-spread with the male perched on the cattails. A similar posturing was observed when males approached a female dummy. In repeated observations of this display before a dummy, the males walked rather stiffly with raised rump feathers and lowered head, occasionally pausing to rest or to give song-spread. This display is similar to part of the male precopulatory display (Fig. 4*d*, *e*). It may be considered an indication of a high level of sexual excitement.

Similar displays were also given on several occasions to other males early in the season before any females had arrived On March 6, 1951, an adult male at least three years old repeatedly held his wings outspread and quivering while giving the "ti-ti- . . ." call. This display was given alternately with full song-spread and erect epaulets to approaching flocks of male Redwings, as well as to approaching individuals, including one first-year

male. From March 12 to 27, 1952, several different males were observed giving this display to other males. It seemed especially to be directed by residents toward new males, which often came in without song and with epaulets more or less concealed. These observations suggest that responses in the male which are normally geared to the female may be set off momentarily by movements or postures in other males which in part resemble or are suggestive of female characteristics. However, this does not imply an outright failure of sex-recognition.

Females sometimes flew in quietly and remained perched near males without making any apparent sound or motion, appearing quite relaxed. Although these females might evoke a display in the male they sometimes flew away quietly afterwards without being chased. Established females occasionally flew into the marsh without arousing any special interest from the males which were apparently able to recognize them as one of their own or a neighbor's mate. In many cases formerly-resident females appeared to arrive at the marsh late in the evening after most activities had ceased. A few which were actually observed dropped right down into the cattails with little hesitation. These females were often found within an hour after sunrise the next morning sitting quietly on a male's territory, behaving like established females, i.e., they stayed on the territory and sang to passing females. Some females showed much "tail flashing," that is, rapid spreading and closing of the rectrices, sometimes accompanied by slight movement of the primaries. (This occurs in both sexes, but is especially prominent in females). Rarely, females visited several territories before finally settling in one, even though they sometimes had remained for several days in one territory. This was regarded as very unusual behavior since ordinarily if a female remained for one day in a male's territory she kept that position. Females which were probably transients (or young?), however, often visited several territories in rapid succession.

Once a female has settled on a male's territory and has become paired she may receive little attention from him, particularly if she remains low in the cattails and quiet. However, her quarrels with other females settling within the territory nearly always bring forth aggressive interference by the male. At times the female follows the male around as he shifts about in territorial defense. She may alight a few feet from him and slowly move toward him, upon which the male usually retreats. The newly-established female may also move toward an adjacent male in the same way for a few days, but in this case she is apt to draw an aggressive response from which she retreats. At other times the male shows an interest in his mate by diving at her, by giving various displays near her, and by sometimes following her off the marsh. Occasionally males followed their females as

they circled high over the territory or marsh. These flights were usually silent and were seldom accompanied by other birds. Generally the male keeps himself between his mate and the neighboring males, meanwhile giving song-spread, especially when they approach his borders. He is always active in driving intruders from her vicinity. Such behavior may be seen throughout the season.

Pair Formation

Pair formation apparently begins (or actually occurs) when a female enters a male's territory. The male appears to assume a proprietary interest in a female which stops in his territory and suitably stimulates him. In several cases when a newly-arriving female which had briefly visited one territory entered another, the owner of the first territory dashed into the next territory to bite or to strike her. These reactions were repeated several times under experimental conditions in which a female dummy was placed in one territory and then moved to another. The first male persistently trespassed in order to strike the dummy in spite of vigorous attacks by the second male. The male thus appears to "claim" the female from the first moment, but the latter's interest appears to be mainly in potential nest-sites. Newly-arrived females sometimes fought hard and long to keep other females from encroaching on their territories.

Williams (1952:9–11) believes that pair formation in the Brewer's Blackbird occurs gradually over a long period right up to nesting. Males and females remain in mixed flocks throughout the non-breeding season, and as the breeding season approaches they begin to show signs of pairing, i.e., they walk about together and the males guard certain females. In Redwings, pairing behavior is *inconstant* at first, gradually becoming more constant as "true" pairs form. Former pairs often reassociate and these show less *inconstancy* than do new pairs. Inconstancy in the Redwing during the period preceding nesting is probably held to a minimum by the territory system. Females attached to one male usually are driven out of adjacent territories by the occupants; moreover, once a female has chosen an area for nesting she shows little inclination to search elsewhere. There is thus little wandering except on first arrival. The concept of gradual pair formation therefore cannot be applied to Redwings. However, some strengthening of the bond undoubtedly occurs through association during the ensuing days of breeding, although it probably never reaches the level of that shown by the Brewer's Blackbird. The stronger pairing bond indicated in the latter species probably results from the longer association of the pair.

Courtship

Symbolic Nesting

"Symbolic nesting" or "symbolic building" are terms used by Nice (1943:

178–179) to describe the manipulation of nesting material by the member of a pair which does not ordinarily help construct the nest, or "unnecessary" handling by the other member (or both, if both build) prior to actual building. Such behavior is characteristic of courtship in many species, from grebes and cormorants to songbirds. According to Nice (*loc. cit.*), although the female Song Sparrow alone builds the actual nest, young males (2 to 3 months old) show nest-*molding* behavior, and adult males sometimes carry nesting material, particularly during the preliminary stage prior to nesting. Both sexes in this species indulge in symbolic nesting, but the male does so more frequently than the female.

Symbolic nesting occurs in both sexes in the Redwing, but it is more pronounced in the male. Since it is also somewhat difficult to differentiate between symbolic nesting and the onset of "real" nesting behavior in the female, I shall refer mainly to the male's activities. His sequence of behavior has been grouped under the terms *symbolic nest-site selection* and *symbolic nest-building* (the former leading right into the latter). This behavior was observed mainly from the arrival of the female on the male's territory until coition and subsequent egg-laying.

Symbolic nest-site selection.—In general, the male "crouches" near the female (see Figure 4*a*), gives song-spread, then flies to a clump of cattails to which he clings, while holding his wings up over his back ("elevated wings," Figure 4c). Sometimes he holds this posture for several seconds and may glance back over his shoulder toward the female which often flies down near him. If the female comes, he may leave her to fly back to his perch; but more often he slowly works through the cattails, or *crawls*, still holding his wings partly upright (Fig. 4c). Then he stops, *bows* with beak between his feet and bites at the nearby cattail blades or breaks off bits which he manipulates in the manner of a female building a nest. Often the female quietly follows him through the same tortuous path and watches him. This entire sequence, or portions of it, may be repeated many times. Usually this behavior is given to the mate, but on two occasions males gave fragments of it before strange females which flew low across their territories.

The male's flight to the clump is slow and usually appears awkward, the wing-beat being below body level. Sometimes a male will fly from clump to clump continuing this strained flight. A few observations of Yellow-headed Blackbirds (*Xanthocephalus xanthocephalus*) made by me in 1955 convinced me that a pattern of behavior similar to symbolic nest-site selection in the Redwing occurs in that species. Wetmore (1920:403) stated that as the male Yellow-headed Blackbird started toward the female the ". . . wings were brought down with a slow swinging motion and were not closed at all . . ." Ammann (1938) also noticed this kind of flight in

this species and pointed out how noticeable the white wing-patches were at this time. This is apparently the kind of flight described by Howard (1929:9) as expressing sexual excitement. He states: "Two forms of sexual flight are common in bird life; one like the flight of a butterfly, the other like that of a moth. In the former the wings are fully expanded and slowly flapped; in the latter, partially expanded and rapidly vibrated. In both forms the bird travels slowly."

As the Redwing male hits the clump he commonly utters a low, harsh, buzzing "hahh . . ." or "shhh," the "growl," a call often given in threat when harassing other species, immature males, occasionally his mates, and other females (?), but apparently not other adult males. (Females sometimes emit a similar call when driving off other species.) This call is sometimes quite long and is given with open beak, the beak sometimes being held open for a short time afterward. Although generally a low sound, it is quite audible and may be heard from at least 100 feet. Although it may be given at any time during the sequence outlined above, the growl is usually given as the male peers into the cattails, either from the outside of the clump or as he crawls and bows within. On one occasion a male came up out of a clump and faced his mate while giving this call.

While the male clings to the clump his wings may be held completely erect, sometimes even touching over his back; but at other times they may be only slightly elevated and slowly flapped, or held out with only the tips shaking. In one case a male raised and flapped his wings successively higher and faster as his mate approached him in flight. This observation and others suggest that the higher position indicates a greater intensity. In one unique case a male which appeared to be unusually excited during an intense elevated-wing display, uttered a series of short, high-pitched notes which increased in tempo and pitch to the end.

The male's use of the threat call or growl during symbolic nesting recalls the use of similar calls in other species. A "harsh rasping note" was given by a male Mockingbird (*Mimus polyglottos*) when it went into a potential nest-site during symbolic nest-building (Laskey, 1933:31). Tinbergen (1939: 25) stated that during the pre-oestrus period of the female Snow Bunting (*Plectrophenax nivalis*) the male and female frequently go about together inspecting little rocky crevices of the sort in which the female eventually builds her nest. "When entering a hole the male often uttered a sound that to us was indistinguishable from the sound that was heard from a threatening bird. We did our best to detect a possible difference, because we did not expect to hear the same call in such widely different situations, but we must confess we did not succeed."

Occasionally song-spread was given during the sequence. When this

occurred, the sequence appeared to be momentarily interrupted. In several instances males came up out of the cattails to sing and then crawled back and resumed their displays. In one instance a male continued to display when an immature male dived at his female which was watching nearby.

Lack and Emlen (1939:226) state that the male Tricolored Redwing (*Agelaius tricolor*) would often ". . . flutter slowly down into the cattails until out of sight. . . The female sometimes followed, and his behavior presumably influenced her selection of a nest-site and mate." Although male Redwings often went repeatedly to a particular clump to display, I did not observe any case in which a female built her nest in the "selected" clump. In several cases, however, the nest was built within a few yards thereof.

Symbolic nest-building.—Ordinarily symbolic nest-site selection ends with the bowing movement in which occasionally the male bites at the nearby cattail leaves or breaks off bits with which he "plays." However, more elaborate sequences of nest-building have been observed. Two such cases were recorded in May, 1950. In one case a male was courting a female which had been present on the marsh for several days, but which had just come to his territory. This male displayed at the nearly-completed nest of another of his females which was absent at the time. While the new female watched, he went inside the nest and then went through the motions of building, forming it with his chest, lowering his head into it, and picking here and there, meanwhile holding his wings erect. After two minutes the female moved away from him. He went near her and then she followed him back near the nest and again he went through the nest-building behavior, although this time not in the nest. The female moved away from him again and then he once more led her back. Finally he went up to the nest and, while the female watched, he lowered his head into it and then reached outside and appeared to pull in material. This observation is of special interest since in many hours of watching I have never seen the male take part in actual nest-building. A report by Hackett (1913) stating that the male helps construct the nest may possibly have been inspired by an observation of a male engaged in symbolic nest-building.

In a second case a different male, after leading a new female into a clump of cattails, broke off some dead leaves and pulled at a piece of string that had been left there in trapping operations. When the female moved away from him, he went to her, bowed with raised wings and erect epaulets, and then climbed up to an unfinished nest nearby, where he gave the growl call. Then he reached into the nest and picked at the nest material. Later he went through the same behavior with this female in a cattail clump at a different place in his territory.

Such behavior by the male in a species where only the female builds the nest seems remarkable. However, a few cases have been reported in which males of such species apparently constructed complete nests. Dawson (1921: 92) reported that a male Hooded Oriole (*Icterus cucullatus*) ". . . was observed day after day as he constructed a nest on the underside of a palm leaf." And Nuttall (1832:157) tells about a male Baltimore Oriole (*Icterus galbula*) building a nest. Schantz (1937) watched a male Song Sparrow construct a complete nest in which a female later nested. In referring to the latter case, Nice (1943:211) said that the latent nest-building ability, appearing in most male Song Sparrows in the symbolic manipulation of material, developed through practice when this male was mateless for two years.

Symbolic nesting by the male apparently occurs in several other icterids besides the Redwing and the orioles mentioned above, in which the female alone builds the nest. Petersen and Young (1950:467) reported that a courting male Bronzed Grackle (*Quiscalus quiscula*) ". . . repeatedly picked up and moved a bit of paper with his bill, replacing it in a crude nest consisting of a few twigs in a crotch about 25 feet above the ground. He frequently lifted his wings, spread his tail, and '*skreeked*'. The female, perched about a yard away, also held a scrap of paper in her bill, but she remained more quiet than the male." Williams (1952:12) states that in the Brewer's Blackbird "The male of the pair is sometimes the first to hold nesting material in the bill, but he rarely places it at a site." Although symbolic nest-building has not been observed in either of the meadowlarks, a hand-raised male Eastern Meadowlark (*Sturnella magna*) showed nest-molding behavior (Nice, MS, 1950). Mrs. Nice also observed nest-molding behavior in a hand-raised male Redwing at 39 days of age (1950:88). Ammann (1938:116) quoted Wheelock as stating that "she has known the male Yellow-headed Blackbird to make a pretense at nest-building a few feet away from the real cradle . . ." And Ammann (*loc. cit.*) observed males of this species ". . . casually pecking at a few strands of nesting material attached loosely to the reeds near finished nests." Although the parasitic Brown-headed Cowbird (*Molothrus ater*) does not build a nest, Laskey (1950:160) twice saw a courting male Cowbird ". . . toying with a dead leaf or a piece of debris while bowing to a female."

Symbolic nesting in male Redwings as well as in these other species may represent vestiges of functional behavior in a time when the male played an active part in the actual activities of selecting a site and building a nest. Although in nearly all of the Icteridae the nest is built solely by the female, in cowbirds we find at least one exception (Friedmann, 1929). The most primitive species, the Bay-winged Cowbird (*Molothrus badius*), is non-

parasitic but mated pairs locate and fight for the possession of nests of other species of birds which they then occupy. Usually some alterations of the nest are made, and when no nest is readily available they build their own, the *male* generally building more than the female. And in the Shiny Cowbird (*Molothrus bonariensis*), which is parasitic and which normally does no nest building, both male and female have been seen attempting to build. According to Beecher (1950:52) the cowbirds are very close to the original primitive form, the buntings or Emberizinae, from which he believes the blackbird sub-family (Icterinae) has arisen.

Possible functional significance of "symbolic nesting" behavior.—In 1953 I observed that when an incubating female was frightened from her nest by my jerking of the nearby cattails by means of a piece of string, her mate would often come in response to her alarm cries and fly down near her nest. When he withdrew the female would return to her nest. This happened repeatedly. Sometimes when the male was absent or otherwise occupied and did not come to her calls the female would fly about, scolding for several minutes, and would fail to return to the nest until the male arrived. The male's visit nearly always sufficed to quiet the female. Once when a female which was building the basal portion of a nest became greatly alarmed by the click of a concealed camera, her mate flew down near the nest and finally hopped right into it and peered about. These actions of the male somewhat resemble his behavior in symbolic nesting and suggest that the latter may have a "reassuring" effect upon the female.

This interpretation is substantiated by observations of symbolic nesting in "non-courtship" situations. During the egg-laying period the female is irregular in incubation and the male, which sometimes appears restless or agitated when the female is not on the nest, may give symbolic nest-site selection near the nest in what suggests an apparent attempt to induce her to return. On May 28, 1950, in the morning of which a female laid her first egg, her mate was watched from 5:15 to 6:30 p.m., while she was absent. Toward the end of this period the male flew back and forth in his territory and finally flew to the nest and "craned his neck to peer in . . ." From 8:00 to 9:00 a.m., and from 6:00 to 7:00 p.m. the following day, the male went through complete sequences of symbolic nesting (even to the breaking of cattail leaves) near her, but especially near her nest (containing two eggs). He visited the nest in conspicuous display attitude as if in an attempt to lead her into it. On the next day she laid her third and last egg, and again, from 5:00 to 7:25 p.m., her mate repeatedly went through "nest-site selection" behavior. When she finally settled on her nest he flew to the other end of the territory, where he remained perched and quiet. On succeeding days she kept on her nest in more or less constant incubation

and the male no longer showed the "courtship" behavior. In another case (May 22, 1950) a female was kept off her nest by a trap which had been placed directly over it. The male went down near her, suddenly bowed, elevated his wings, and entered a dense clump of cattails where he bowed and manipulated cattail blades while the female watched from nearby.

In many species during the egg-laying period or incubation period the male performs nidocentric displays directed toward its mate. Nice (1943:224–225) offers this explanation: "A bird instinctively responds to certain situations; the situation eggs-in-nest implies mate-on-nest-much-of-the-time; if the second element in the situation is not functioning he is disturbed; if his mate has disappeared he starts to sing (for her or another); if she is around, he tries to get her into the appropriate situation."

Sexual Chasing

Sexual chasing or pursuit of the female by the male during the courtship period has been described for many song-birds (Howard, 1920, 1929; Tinbergen, 1939) and for several non-songbirds (Hochbaum, 1944; Sowls, 1951). It has been noted in the Redwing by Nuttall (1832:171); Audubon (1834:349); Allen (1914:91); Linsdale (1938:141-142); Mayr (1941:53); Smith (1943:190); Mehner (1950); and Beer and Tibbitts (1950:68). Sexual chasing has also been observed in the following icterids: Bobolink, *Dolichonyx oryzivorous*, (Nuttall, 1832:187); Brewer's Blackbird (Williams, 1952:10–11); Brown-headed Cowbird (Friedmann, 1929:158); Yellow-headed Blackbird (Ammann, 1938:102–103); and Wagler's Oropendola, *Zarhynchus wagleri*, (Chapman, 1928:136); but apparently it does not occur in the highly-colonial Tricolored Redwing (Lack and Emlen, 1939:227).

More than 100 sexual chases were recorded in detail in this study. In nearly every case these chases involved birds which had already paired. Howard (1929:70), in discussing sexual chasing (his "sexual flight") stated: "Sexual flight is a certain indication of pairing; I have never known a female desert a male once it had occurred." Sexual chases between pairs of Snow Buntings usually indicated that the birds ". . . had mated and that the female would stay with the male she had chosen." (Tinbergen, 1939:21). Sexual chases in the Brewer's Blackbird are believed to be part of the mechanics of pair formation ". . . since they occur more frequently in pairs forming for the first time and apparently cease when the pair is formed." (Williams, 1952:10–11). Pair formation in this species, however, is considered to be an extended process occurring over a considerable period prior to nesting (see Pair formation).

Sexual chases in the Redwing are usually marked by aggressive pursuit by the male and rapid elusive flight by the female. Females occasionally flew into obstructions and even into the water. Sometimes the female stays

within the male's territory, but often she flies out over neighboring territories. Occasionally these flights take her far from the male's territory, but she usually returns at the close of the chase. Sex chases are often preceded by signs of sexual excitement in the male, and in most cases it is the male who first springs into action, suddenly diving at the quietly-perching female. In some cases, however, it seems to be precipitated by special situations which bring the female into sight of the male. For example, the male seems to be stimulated by the appearance of the female carrying nest material, particularly when she carries it for a greater distance and more openly than is ordinary or necessary. Females in conflict call forth aggression by the male, and this may lead to sexual chasing. Various calls of the female, or simply her arrival on the territory after an absence, may evoke a sudden chase.

The ending of a chase is sometimes as sudden as its beginning, the participants often stopping shortly after they have begun. Usually the male is the first to stop and, as soon as he quits, the female stops fleeing, often landing in sight of the male and usually on his territory. The extreme development of a chase occurs when the male overtakes and hits or catches the female. This may occur in the air or on the ground, either on or off the territory. In seven observed cases the male hit the female or seized her by the rump feathers. In one case a male caught the female in the air and held onto her while both birds fell together some 40 or 50 feet down into the marsh. Hochbaum (1944:42) saw this occur once in Mallards (*Anas platyrhynchos*) and once in Pintails (*Anas acuta*). A male Redwing sometimes held a female by the rump feathers for several seconds while she struggled to escape. On one occasion a male was seen holding a female in this manner for over 30 seconds while she struggled to free herself. In another unusual case a strange male which intruded on a territory to chase another's female, caught her by the rump feathers and then momentarily stood on top of her (female response not apparent). Seizure of the upper tail coverts or the rectrices of the female during sexual chasing has been described for the Reed Bunting, *Emberiza schoeniclus*, (Howard, 1929:7), the Snow Bunting (Tinbergen, 1939:21), and the Canvasback (*Aythya valisineria*) (Hochbaum, *op. cit.*:29).

Biting or seizing of the rump feathers was also seen under experimental conditions. Males which had courted a mounted female in their territories repeatedly flew after it and bit or seized it by the rump feathers when it was placed in a neighboring territory. Noble and Vogt (1935:280) placed a female dummy before a Redwing male on his territory and noted that ". . . he flew back to the female mount and attempted copulation. He then pecked this mount at the base of the tail, both above and below, before

again attempting copulation. . . When the male did not evoke a response on the part of the female mount, he again resumed the cloacal pecking until he knocked the mount to the ground." Only female mounts were so pecked and the authors interpreted such pecking as ". . . apparently a sign of annoyance on the part of the male." (In a similar experiment of my own in June, 1955, a male approached a female dummy which was set up in precopulation attitude in his territory, displayed to it, mounted, showed annoyance and pecked vigorously at the rump and cloaca. "Annoyance" behavior was accompanied by a low "tch-tch-tch . . ." call similar to the call given at the onset of many sex-chases [see below]. In another instance in which a freshly-shot female was propped up with the aid of wires so that the cloaca was clearly visible, the male approached and pecked earnestly at the exposed cloaca. Such behavior may be substitute or outlet behavior for sexual excitement, and there may possibly be some stimulation to the female in these attacks on her cloacal region.

There is some suggestion that female Redwings may threaten strange males which attack them, and in two unusual cases, females apparently momentarily fought with their own mates (May 29, 1950; May 12, 1951). Ammann (1938:102–103), states that when occasionally a male Yellow-headed Blackbird caught a female after a sexual chase the female vigorously resisted the male's attempts to copulate. Tinbergen (1939:21), in describing sexual chasing in Snow Buntings, says that the ". . . female tried to escape and fought with great perseverance" with her mate. And Howard (1929:22) notes that Yellow Buntings (*Emberiza citrinella*), at the conclusion of a sexual chase, may face each other in the air, apparently fighting. Whatever the outcome of a Redwing chase, both members of a pair might be sitting quietly side by side seconds after its end. Similar behavior was observed in Wagler's Oropendola by Chapman (1928:136).

Copulation was never observed as the immediate end of a sex chase in the Redwing. However, on May 25, 1950, a male engaged his female in a sex chase and then, two minutes later, flew up to her again and mounted in apparent copulation, although she showed no signs of sexual readiness beyond sitting still. Eight minutes later, however, she showed extreme sexual readiness (complete precopulatory behavior) and copulation then clearly took place. In his final approach to the female the male's posturing was more extreme than that of his two earlier approaches. Sex chasing may probably be considered an indication of the female's unreadiness. Eventually, however, the female comes into readiness and on such an occasion one might observe copulation closely following a sex chase, as described above.

Song-spread often accompanies chasing, occurring both before and, in

part, even during the rapid flight. A call which resembles the middle phrase of the "flight song" and which has been heard in other situations suggesting a threat function is often given by the male during the chase This call is a high, loud, and nasal "tch-tch-tch . . ." often repeated several times. It may be given before as well as during the chase.

Group sexual chasing.—Often other males from neighboring territories join a chase of the type described above. It then becomes a group chase. Although the basis for a group chase is usually a pair, occasionally a female may become the center of a group chase in the absence of her mate. Even in the confusion of a group chase, it is usually her mate who catches and seizes her. In one case a male returned to strike his female a second time after a neighbor male had intervened to hit her.

Group chases are typically noisy affairs, all males involved tending to give rapid and repeated song and even some spread-display, while on the wing. At this time the typical "oak-a-lee" song is given quite hastily, so that the first part is slurred and the last emphasized. Friedmann (1929:161) describes a similar sexual flight in the Brown-headed Cowbird in which two males were ". . . singing and attempting to display in mid-air . . ." while following a female. It is not clear just what causes other males to join a chase. They always appear interested in each other's chases but do not always join them. The movement of others to join is usually general — when one flies toward a chasing pair, others follow. Group chases in the Reed Bunting appear to be very similar to those described above (Howard, 1929:7). "Owing to some seasonal organic change she is in a condition to stimulate and so to attract. . . as yet she has acquired no experience of boundaries, and straying, passes outside the dominion of her mate . . . she evokes in turn the sexual nature of each neighboring male; and they, on their part, become excited, and their excitement may terminate in the sexual flight." I think that in the Redwing, at least, the group response may often be of a more general nature, perhaps akin to group flocking about a predator. In the course of one group chase, several immature males and females gathered in the vicinity. In some instances groups formed so rapidly that it appeared the males were responding to the chasing pair rather than directly to the female. The "tch-tch-tch" call mentioned above seems to arouse other males. Very often just after a chasing male gives that call, his neighbors fly to join the chase, meanwhile giving the same call. On at least one occasion I have seen males fly to join a chase when the pair was out of their sight behind shrubbery. These birds seemed to respond to the vocalization of the male. In a few cases males evidently were aroused by the calls of others' females. The extended chase, low and over several territories, usually, but not always, brings about group

behavior. Sometimes neighboring males fly into a territory to join a chase which is limited to that territory. The stimulus to chase a female or to join a chase, seems to vary depending on the particular circumstances. It should be noted that the males which join chases are usually themselves in the midst of courtship with their own females, and hence leave their mates to jointly chase another's mate. The behavior of a strange male which catches a female is apparently the same as that of her mate.

Nuttall's statement (1832:171) that during group chase the several males do not show any "jealous feud" with each other seems not entirely true. I think that the great amount of song which occurs during the group chase is an indication of the mutual aggression of the males rather than a direct response to the female. Almost always, at the close of a chase, and often before, the male mate, or owner of the territory on which the group gathers, turns to evict his neighbors. Sometimes the pursuing male even turns away from his female to do this. However, this may not always be the case, especially when the chase ends, as often happens, on a foreign territory or even on a neutral area. What seems more remarkable is that other males which are approaching a chasing pair often turn back in flight when the chase ends.

Group chasing is evidently the kind of chasing that Nuttall (1832), and Audubon (1834) referred to. Audubon's idea that the female Redwing receives the attention of a number of males in group sexual chase and then chooses one of them as her mate (*op. cit.*:349), does not seem in agreement with present observations. Beer and Tibbitts (1950:68) also apparently had such chases in mind when they described a "teasing" flight, involving one female and several males, which purportedly ended in promiscuous copulation. They implied that this was a general occurrence. I have no observation of promiscuity in Redwings, but at the close of one group chase four males in courting postures briefly surrounded a female on the ground and then dispersed.

Stolen matings.—Sometimes in non-promiscuous species, stolen matings occur. Howard (1929:42) says this of the Yellow Bunting: ". . . stolen matings . . . are by no means uncommon where territories adjoin and different females are in different stages of development; and despite the efforts of the owner to prevent it, a male will sometimes succeed — as far as one can tell — in reaching a sexual union." Nice (1943:184–185) says that in the Song Sparrow stolen matings do not occur.

I have no record of a stolen mating in the Redwing, and consider it unlikely, at least on the territorial grounds. Males do cross boundaries to harass another's female, and in one case a strange male even stood on top of the female. However, no copulation was ever observed under such

circumstances. Even at a later time, when the members of the pair are about to copulate, although neighboring males may move up to their near-borders, molestation of the pair is rare or absent. Females generally are recalcitrant to strangers, and their mates are completely so. This is well illustrated by the following observation made off the study area at a place where plowed fields adjoined a small marsh. A resident female flew into the field to feed several hundred feet from the territory, where she was soon joined by a strange adult male. Seconds later she came flying back, giving alarm calls, with the male in close pursuit. When they reached the territory she flung herself into the cattails, and her mate, along with several neighboring males, drove the intruder away.

Period of sexual chasing.—Sexual chasing occurred between members of pairs in varying degree with no particular order of frequency or severity from the first few days of meeting for at least as long as 11 days. In some instances females were with males on their territories for several days before chasing was observed. Sex chases occurred throughout the breeding period, however, owing to late arrivals, remating, and renesting. The period of chasing is possibly correlated with physiological and psychological changes in the female, for once copulation occurred sexual chases were noticeably fewer or absent. Tinbergen (1939:21) stated that in the Snow Bunting ". . . weeks may pass, after the female has taken a mate, before she is willing to copulate . . ." and sex chasing occurred throughout this period. In a few cases a recurrence of chasing was observed in Redwings just prior to second nesting. In one case a violent chase occurred 22 days after a pair had fledged their first young.

The meaning of sexual chasing.—Tinbergen believed that sexual chasing in the Snow Bunting originated from attempts of the male to copulate (1939:30). "When the female did not take notice of the male, that is, when she did not adopt the attitude of readiness, she fled, and a sexual flight originated." The fact that the female flees before the postures or advances of the male is taken as an indication of her sexual unreadiness, since later, upon similar advances, she assumes proper copulatory postures and receives her mate. Howard (1929:11, 40) states that ". . . the behavior of the male is a genuine attempt to complete the sexual act . . . eventually when he flies excitedly towards her and settles beside her, she stays, postures, etc., and copulation results." Nice (1943:174–175) considered "pouncing" in the Song Sparrow analogous to sexual chasing in the above species. (An actual chase does not occur in the Song Sparrow; when the male pounces on the female, the latter usually stands still and at times even fights back.) Nice stated (*loc. cit.*) that ". . . pouncing has no immediate connection with copulation. . . pouncing on the mate may be a technique of the male for

impressing himself upon his mate . . . of making his presence keenly felt!" Although sexual chasing in the Redwing is not connected directly with copulation, it is part of a pattern of actions and reactions which leads to copulation.

Precopulation and Copulation

During precopulatory behavior the female gives a long, rapid series of soft, high notes ("whimpering"). In low intensity the call is slow and these notes seem composed of two sounds: "tse-sit" or "seek-seek," but later the speed of delivery increases and these become: "tsee-tsee-tsee. . . " The rapid series may also gradually become slower and end with double notes. This call may be given alone but ordinarily it is accompanied by rapid spreading and closing of the primaries and, to a lesser extent, the rectrices, while the wings are held close to the body (Fig. 4*f*, *g*, *h*). The whimpering call and wing flutter are usually given while the Redwing is perched, sometimes quite high in a tree but usually on or near the ground. Occasionally the female displays in flight. This display is similar to the female "generalized display" of the Brewer's Blackbird (Williams, 1952:5–7), and, as in that species, is used long before copulation actually begins. It also precedes the high-intensity display (described below). As the intensity of the display increases the female leans forward and lifts her tail and wings, exposing the cloacal region (Fig. 4*i*, *j*, *k*). At high degrees of intensity the female sometimes raises her head slightly while whimpering and fluttering her wings (Fig. 4*g*). Complete readiness for copulation is indicated by both the tail and head being tilted upward sharply with the beak sometimes held open. At this time the body is depressed, sometimes with the breast resting upon the ground or perch. During copulation the female usually rests upon her tarsi with bill and tail still raised. In one observation the female swung her tail to one side and clearly extruded her cloaca just before the male mounted.

The male reacts to the female's precopulatory display by first perching close to her in the "crouch" position (Figure 4*a*). If her display is limited to the whimper and wing flutter he may do nothing more and may pay little attention to her, but on one occasion a male approached while displaying and mounted a female which had been sitting quietly on the ground. When the female goes into full display the male typically drops down to the floor of the marsh, flutters his wingtips while holding them out, either raised or lowered, and gives a soft whimpering cry somewhat similar to the female's, but not as loud and usually not as long. Then, with erected and sometimes violently-shaking epaulets, puffed-out feathers, lowered and spread tail, and lowered head, the male slowly, and often silently, walks stiffly toward the displaying female (see Figure 4 *d*, *e*).

If the birds are in a tree the male sidles along on the branch until he reaches the female. When approaching on the floor of the marsh he sometimes walks for several feet, awkwardly climbing over obstructions. On one occasion a male walked about five feet along the ground toward a displaying female and then, still fluttering his wings, flew up over an intervening cattail clump and landed directly on top of the female which had been out of his sight. Wetmore (1920:403), reported a very similar behavior for the Yellow-headed Blackbird — when approaching their mates, the males ". . . clambered stiffly along, hobbling over masses of bent-over rushes, with heads bent down, tails drooping and back humped. . . "

As the male nears the female he may begin to quiver his wings more and then raise them higher, especially as he mounts. Then he may flap his wings rapidly and sometimes may even hold them almost vertically while on top of the female. He may also do this before mounting her. In a few cases males approached with wings lowered to the ground and mounted the female without raising their wings. The male mounts the female from the rear, slowly moving around her to do this when he approaches from any other direction, since the female usually remains in a fixed position. He remains on top of her for a very short time, perhaps two or three seconds, and then steps off. Usually the male mounts only once but occasionally a male may mount more than once. However, I have never seen a male mount more than three times in quick succession. After dismounting the male usually moves off without any conspicuous display, but occasionally he may continue to move his wings, even though walking away from the female.

During copulation the female is apparently silent and motionless, but afterward she may both call and flutter and sometimes preen. On one occasion the male left the territory shortly after copulation occurred and the female then promptly went into precopulation display again, giving an even louder and more rapid whimpering call than she had previously given.

Wetmore (1920:404), apparently observed precopulatory behavior of the male Redwing when he wrote: "one male . . . often slowly ran along the ground with wings partly spread and half-raised and epaulets showing to their fullest extent, a very pretty display." Tyler (1923:697) wrote: ". . . he faced her with his wings partly spread and, although I was immediately in front of him, I could see practically the whole of his shoulder-patches. . . an actual courting maneuver . . . proved by the immediately subsequent action of the pair."

The precopulatory behavior of both the male and the female Brewer's Blackbird (Williams, 1952:5–6) closely resembles that of the Redwing. Similar behavior has also been noted in the Tricolored Redwing (Lack and

Emlen, 1939:226); the Yellow-headed Blackbird (Ammann, 1938:104); the Snow Bunting (Tinbergen, 1939:29); and many other species.

Length of the "Courtship" Period

The length of the period between pair formation and the laying of the of the first egg averaged 20.7 days for four pairs for which complete data are available. In two pairs which were closely watched, copulation was observed for the first time four days and three days, respectively, before their first eggs were laid. I have no record of copulation after egg-laying commenced, but I have observed females which had eggs in their nests engaged in precopulatory behavior. The earliest record of copulation was April 30 (1949).

Courtship Feeding

In many species of birds the male feeds the female during courtship or during incubation. Usually the male brings food to the female, which begs like a young bird (Lack, 1940). I observed no signs of courtship feeding in the Redwing although it has been reported for the following icterids: Baltimore Oriole (Brackbill, 1941), Yellow-headed Blackbird (Roberts, 1909:374), Rusty Blackbird, *Euphagus carolinus*, (Kennard, 1920: 420), Melodious Blackbird, *Dives dives*, (Kendeigh, 1952:271), and the Brewer's Blackbird (Williams, 1952:13–14).

Distraction Display

I have never observed distraction display (injury feigning) in the Redwing. However, F. V. Hebard states (pers. commun.) that he once saw a male engaged in this behavior. It has been reported in two other icterids, the Eastern Meadowlark (Hebard, MS) and Bobolink (Hebard, MS; Nero, 1955).

Summary

From 1948 through 1953 observations were made of a breeding colony of Red-winged Blackbirds, most of the members of which were individually marked with color-bands, at Madison, Wisconsin.

Adult males arrived between March 6 and April 21. Females arrived between April 8 and May 7. Most of the birds left the breeding marsh by August, but two males were seen within three miles as late as October 23. More than half of all the marked birds returned at least once; a few returned for several successive seasons.

Displays consisted of various movements or positions of the wings, and usually involved exposure and erection of the red wing-coverts. "Song-spread" was the most common of these and was prominent because of the loud vocal accompaniment. Although this is mainly a male display, an

analogous display with a different song was given by females. Males also had a "flight-song" involving a different vocalization. Both sexes indulged in "bill-tilting," a threat display in which the beak is pointed upward to members of the same sex. This was most commonly seen between adjacent males meeting on the borders of their territories. Females often raised and flapped one or both wings when approached by their mates during the period when they were feeding young. The significance of this display was not clear. A tense crouching posture of the male seemed an indication of sexual interest since it appeared to be directed only toward the mate.

Pair-formation began, or actually occurred, when the female entered the male's territory. The pairing bond existed only during the breeding period. The length of the period between pair-formation and the laying of the first egg averaged 20.7 days for four birds for which complete data were available. Single broods were usual, but three cases of double broods (all successful) were recorded. Polygyny was common, but no more than three females ever were observed with one male; two was average.

Male "courtship" behavior consisted mainly in slowly flying away from the female down into the cattails. The male then displayed with wings elevated over his back, crawled through the cattails, bowed, and picked at nesting material. This sequence was termed "symbolic nest-site selection." A related, less common display was called "symbolic nest-building." Sexual chasing, or pursuit of the female by the male, was a common occurrence. Chasing occurred normally between members of a pair during the period between pair-formation and egg-laying. Copulation was never observed at the immediate end of a chase, but chases were seldom observed between members of a pair once copulation had occurred. Neighboring males sometimes joined a chasing pair, forming group chases.

Sexual excitement in females was indicated by a quivering motion of the flight feathers accompanied by a soft whimpering cry. At a higher intensity the tail and bill were raised, the latter sometimes being open. In response to this "precopulation-display" of the female, males assumed a position in which the wings and tail were spread and lowered and then slowly approached the female. Copulation was always of short duration, and usually one mounting seemed to suffice.

Literature Cited

Allen, A. A.
1914 The red-winged blackbird: a study in the ecology of a cat-tail marsh. *Proc. Linnaean Soc. New York*, 24–25:43–128.
1934 The red-wing. *Bird Lore*, 36:128–138.

Ammann, G. A.
1938 The life history and distribution of the yellow-headed blackbird. (Ph.D. thesis, Univ. Michigan Library).

AUDUBON, J. J.
1832 Ornithological biography. Vol. 1 (Philadelphia; Carey and Hart).
BEECHER, W. J.
1950 Convergent evolution in the American orioles. *Wilson Bull.*, 62:51–86.
BEER, J. R., AND D. TIBBITTS
1950 Nesting behavior of the red-winged blackbird. *Flicker*, 22:61–77.
BRACKBILL, H.
1941 Additional cases of 'courtship feeding.' *Auk*, 58:57.
CHAPMAN, F. M.
1928 The nesting habits of Wagler's oropendola (*Zarhynchus wagleri*) on Barro Colorado Island. *Bull. Amer. Mus. Nat. Hist.*, 58:123–166.
DAVIS, M.
1953 Longevity of Cuban red-wing (*Agelaius assimilis*) in captivity. *Auk*, 70:92.
DAWSON, W. L.
1923 The birds of California. (San Francisco; South Moulton Co.).
FRIEDMANN, H.
1929 The Cowbirds. (Baltimore, Md.; C. C. Thomas).
HACKETT, N. L.
1913 Notes on breeding habits of Agelaius phoeniceus. *Wilson Bull.*, 25:36–37.
HOCHBAUM, H. A.
1944 The canvasback on a prairie marsh. (Washington, D.C.; Amer. Wildlife Inst.).
HOWARD, H. E.
1920 Territory in bird life. (London; Murray).
1929 An introduction to the study of bird behaviour. (Cambridge Univ. Press; New York).
KENDEIGH, S. C.
1952 Parental care and its evolution in birds. *Illinois Biol. Monogr.*, 22:1–356.
KENNARD, F. H.
1920 Notes on the breeding habits of the rusty blackbird in northern New England. *Auk*, 37:412–422.
LACK, D., AND J. T. EMLEN, JR.
1939 Observations on breeding behavior in tricolored red-wings. *Condor*, 41:225–230.
LACK, D.
1940 Courtship feeding in birds. *Auk*, 57:169–178.
LASKEY, A. R.
1933 A territory and mating study of mockingbirds. *Migrant*, 4:29–35.
1950 Cowbird behavior. *Wilson Bull.*, 62:157–174.
LINFORD, J. H.
1935 The life history of the thick-billed red-winged blackbird, *Agelaius phoeniceus fortis* Ridgway, in Utah. (M.S. thesis, Univ. Utah Library).
LINSDALE, J. M.
1938 Environmental responses of vertebrates in the Great Basin. *Amer. Midland Nat.*, 19:1–206.
MCILLHENNY, E. A.
1937 Life history of the boat-tailed grackle in Louisiana. *Auk*, 54:274–295.
MAYR, E.
1941 Red-wing observations of 1940. *Proc. Linnaean Soc. New York*, 52–53:75–83.

MEHNER, J. F.
1950 An ecological study of the eastern red-winged blackbird (*Agelaius phoeniceus phoeniceus*) at Pymatuning. (M.S. thesis, Univ. Pittsburgh Library).

NERO, R. W.
1955 Distraction display in the bobolink. *Passenger Pigeon*, 17:34.

NERO, R. W., AND JOHN T. EMLEN, JR.
1951 An experimental study of territorial behavior in breeding red-winged blackbirds. *Condor*, 53:105–116.

NICE, M. M.
1937 Studies in the life history of the song sparrow. I. A population study of the song sparrow. *Trans. Linnaean Soc. New York*, 4:1–248.
1943 Studies in the life history of the song sparrow. II. The behavior of the song sparrow and other passerines. *Trans. Linnaean Soc. New York*, 6:1–328.
1950 Development of a redwing (*Agelaius phoeniceus*). *Wilson Bull.*, 62:87–93.

NOBLE, G. K., AND W. VOGT
1935 An experimental study of sex recognition in birds. *Auk*, 52:278–286.

NUTTALL, T.
1832 A manual of the ornithology of the United States and of Canada. Vol. I. (Cambridge, Massachusetts).

PETERSEN, A., AND H. YOUNG
1950 A nesting study of the bronzed grackle. *Auk*, 67:466–476.

ROBERTS, T. S.
1909 A study of a breeding colony of yellow-headed blackbirds; including an account of the destruction of the entire progeny of the colony by some unknown natural agency. *Auk*, 26:371–389.

SCHANTZ, W. E.
1937 A nest-building male song-sparrow. *Auk*, 54:189–191.

SMITH, H. M.
1943 Size of breeding populations in relation to egglaying and reproductive success in the eastern red-wing (*Agelaius p. phoeniceus*). *Ecology*, 24:183–207.

SOWLS, L. K.
1951 A study of the ecology and behavior of some surface-feeding ducks. (Ph.D. thesis, Univ. Wisconsin Library.)

TINBERGEN, N.
1939 The behavior of the snow bunting in spring. *Trans. Linnaean Soc. New York*, 5:1–94.

TYLER, W. M.
1923 Courting orioles and blackbirds from the female bird's eyeview. *Auk*, 40: 696–697.

WETMORE, A.
1920 Observations on the habits of birds at Lake Burford, New Mexico. *Auk*, 37:393–412.

WILLIAMS, J. F.
1940 The sex ratio in nestling eastern red-wings. *Wilson Bull.*, 52:267–277.

WILLIAMS, L.
1952 Breeding behavior of the Brewer's blackbird. *Condor*, 54:3–47.

SASKATCHEWAN NATURAL HISTORY MUSEUM, REGINA, SASKATCHEWAN, OCTOBER 15, 1955

FOSSIL BIRDS OF THE LATE PLIOCENE OF CITA CANYON, TEXAS

BY ALDEN H. MILLER AND ROBERT I. BOWMAN

Among the extensive collections of vertebrate fossils assembled by the late C. Stuart Johnston from the panhandle of Texas was a small number of bird remains. These, which total 9, are from the locality known as Cita Canyon. This material is now deposited partly in the Museum of Paleontology of the University of California and partly in the collection of the Panhandle Plains Historical Museum at Canyon, Texas. Dr. Donald E. Savage has kindly made it available for study.

The Cita Canyon locality, no. V-3721 Univ. Calif. Mus. Paleo., is 3½ miles south and 13 miles east of Canyon, Randall County, Texas. It is situated on the Newton Harrell-Edd Ranch. The sediments are sandstones of lacustrine or playa origin. The deposits and mammalian assemblage of this locality (Johnston and Savage, 1955) are of Blancan age which is classed by Wood *et al.* (1941) as late Pliocene.

Description of Material

Family Threskiornithidae

Plegadis gracilis, new species

Type.—Left tarsometatarsus, including proximal end and shaft, 44 mm. in length, and lacking medial calcanial ridge of hypotarsus; well preserved; no. 45088 Univ. Calif. Mus. Paleo.; fig. 1 *d*, *e*.

Referred material.—Right carpometacarpus, lacking most of central segment of metacarpal III; well preserved, the appearance of the fossilization being identical with that of the type; no. 3170 Panhandle Plains Hist. Mus. Left ulna, including distal end and shaft, 43 mm. in length; well preserved; no. 3171 Panhandle Plains Hist. Mus.

Diagnosis.—Similar in configuration to both *Eudocimus albus* and *Plegadis mexicana* but tarsometatarsus smaller (Table 1), at least 12 per cent less in width across cotylae.

The tarsometatarsus is referred to the family Threskiornithidae on the basis of general agreement in configuration of the hypotarsus, which in all three genera studied (*Eudocimus*, *Plegadis*, and *Theristicus*) shows a consolidated basal stalk, not perforated by tendinal canals but supporting an open tendinal groove. In the one specimen of *Theristicus* with which comparison was made, there is a very thin bony bridge over the single canal. In all genera of the Ardeidae and Cochlearidae examined, the basal hypotarsal stalk is perforated or deeply cut with two tendinal canals. The non-perforate hypotarsus is also found in the families Phoenicopteridae and Ciconiidae, but the fossil is markedly smaller and shows differences in details of configuration from them.

The carpometacarpus is assigned to the family Threskiornithidae on the

basis of general agreement in configuration to the genera *Eudocimus* and *Plegadis* and particularly the presence of a short "tendinal ridge" located in the middle of the anconal groove of the distal metacarpal symphysis, in line with the process for digit III. There is close familial accord in proportion, especially in the ratio of the length of the distal carpometacarpal symphysis to the total length of the carpometacarpus (Table 2), which is generally of a higher value in the family Threskiornithidae than in the families Ardeidae, Cochlearidae, and Ciconiidae. Comparative osteological material was not available for the families Scopidae and Balaenicipitidae. Recent New World genera of Phoenicopteridae show a value for the "symphysis ratio" slightly greater than that of *Eudocimus* and *Plegadis*, and also the carpometacarpus of the phoenicopterids is of much larger size.

The distal end of the fossil ulna shows no diagnostic features but is of the same general size as the two other fossil elements; therefore it is referred to the same species.

TABLE 1

MEASUREMENTS IN MILLIMETERS OF THE TARSOMETATARSUS AND CARPOMETACARPUS OF FOUR SPECIES OF THE THRESKIORNITHIDAE

Species	Tarsometatarsus				Carpometacarpus		
	Total length	Narrowest medio-lateral width of shaft	Cotylar width	Antero-posterior width of proximal end[1]	Total length	Width of proximal head	Width of distal head
Theristicus caudatus	92.3	5.9	15.2	11.7	73.4	18.0	10.8
	79.2	5.5	14.3	11.0	68.4	16.8	10.4
Plegadis mexicana	113.1	4.3	11.1	11.3	58.0	11.6	7.3
	87.6	3.7	9.1	9.4	50.7	10.0	6.5
	87.5	3.7	9.2	9.3	50.6	10.2	6.8
Eudocimus albus	83.6	4.3	10.2	10.3	57.2	12.5	7.5
	77.7	4.3	10.4	9.1	51.4	11.6	7.2
Plegadis gracilis	–	3.4	8.0	7.9	45.3	9.5	5.7

[1] Measurement taken from anterior surface of lateral cotyla to posterior edge of lateral hypotarsal ridge.

Because skeletal material was available for only three of the 17 genera of the Threskiornithidae listed by Peters (1931), namely *Guara (Eudocimus)*, *Plegadis*, and *Theristicus*, it was necessary to utilize the measurements of wing and tarsus obtained from study skins to eliminate certain genera from consideration on the basis of size alone. Table 3 lists the species which approach the small size of modern *Plegadis* and *Eudocimus* most closely in length of wing or length of tarsus or both. Whereas *Lampribis*, *Harpiprion*, and *Mesembrinus* possess a short tarsus, possibly as short as the fossil, the

TABLE 2
RATIO OF LENGTH OF DISTAL METACARPAL SYMPHYSIS TO TOTAL LENGTH OF CARPOMETACARPUS IN 19 GENERA OF THE CICONIIFORMES

Family	Genus	Ratio
Phoenicopteridae	*Phoenicopterus*	.156
	Phoenicoparrus	.173
Threskiornithidae	*Eudocimus*	.141
	Plegadis	.146
	Theristicus	.117
	Plegadis gracilis	.161
Ardeidae	*Ardea*	.104
	Casmerodius	.117
	Heleroenus	.101
	Botaurus	.119
	Nyctanassa	.106
	Egretta	.114
	Nycticorax	.102
	Hydranassa	.104
	Florida	.103
	Butorides	.106
	Leucophoyx	.111
	Ixobrychus	.124
Cochleariidae	*Cochlearius*	.112
Ciconiidae	*Mycteria*	.083

wing measurements of these three genera and also *Phimosus* suggest a relatively longer carpometacarpus than in the fossil. If *Lampribis*, *Harpiprion*, and *Mesembrinus* are of general build and wing length similar to *Eudocimus* and *Plegadis*, even though short-legged, we may presume that the tarsus would be short but broad and thus not slender as in the fossil.

With respect to the two genera *Eudocimus* and *Plegadis*, the fossil is similar to both of these in the relative slimness of the hypotarsal stalk but it appears to be more closely related to *Plegadis* in size (Table 1). *Theristicus* not only differs significantly in general size from *Plegadis* and *Eudocimus*, but it also lacks the medial "tendinal ridge," possesses a broader hypotarsal stalk, and shows a much larger value for the "symphysis ratio."

Wetmore in 1940 listed no fossil records of *Plegadis*, *Guara* (*Eudocimus*), or *Ajaia* prior to the Pleistocene of North America. The same author later (1944:92) called attention to a fragment of a coracoid from the Upper Pliocene of Kansas which he tentatively relates to *Plegadis* but which was "from one-fourth to one-eighth smaller than the modern white and scarlet ibises and the glossy ibises." It may well be that the coracoidal element from Kansas represents the same small extinct species of *Plegadis* here

TABLE 3
MEASUREMENTS OF WING AND TARSUS OF SEVEN SPECIES OF THE THRESKIORNITHIDAE[1]

Species	Wing range in mm.	Tarsus range in mm.
Eudocimus albus	263–298	78–101
Plegadis falcinellus	225–295	85–110
Plegadis ridgwayi	256–304	68– 97
Lampribis rara	270–290	56– 65
Harpiprion caerulescens	279	58
Mesembrinus cayennensis	290–340	60– 65
Phimosus infuscatus	292	–

[1]Data from various sources in literature.

described from fossil beds of similar though slightly later age in Texas, less than 200 miles to the southwest.

INDETERMINATE CICONIIFORM

A left phalanx 1, digit II, no. 3172 Panhandle Plains Hist. Mus., in a good state of preservation and measuring 32.7 mm. in length, appears to belong to the Ciconiiformes on the basis of general configuration and particularly the outline of the metacarpal facet. Although the fossil is almost complete, this element shows insufficient character to permit more than ordinal assignment. On the basis of length and width of the phalanx, the bird presumably was about the size of *Theristicus caudatus* and thus much larger than *Plegadis gracilis*.

FAMILY ANATIDAE

Anas sp.

The distal end and shaft of a left humerus (no. 3173 Panhandle Plains Hist. Mus.) of a teal is well preserved distally and matches closely in configuration and size the distal end of the humerus of *Anas cyanoptera*. The bone is too broad and stout to be confused with *A. carolinensis*, 9 specimens of which have been available for comparison. The fossil in similar fashion differs from two examples of *A. discors*, but *discors* and *cyanoptera* are such closely similar species that we distrust this difference and think that larger samples of *discors* would show overlap in dimensions with the fossil. Since *discors* cannot surely be excluded and since there is a number of small teals in other parts of the world which have not been examined, the fossil should not be designated as to species; nonetheless it probably represents the modern *A. cyanoptera* of the New World. "*Querquedula floridana*" of the Pleistocene has recently been shown (Wetmore, 1955) to belong to the genus *Lophodytes* rather than to *Anas*.

FAMILY MELEAGRIDAE

Meleagris leopoldi,* new species

Type.—Right tarsometatarsus, lacking proximal end, tip of spur core, and entire internal trochlea and lateral half of external trochlea; well preserved; no. 45086 Univ. Calif. Mus. Paleo.; fig. 1*c*.

Paratypes.—Right tarsometatarsus, complete except for spur core and small part of hypotarsus; well preserved throughout; no. 3169 Panhandle Plains Hist. Mus.; fig. 1*a*, 1*b*. Short section of shaft of right tarsometatarsus including spur core, the tip of core lacking; no. 45087 Univ. Calif. Mus. Paleo.

Diagnosis.—Similar in general shape to the turkeys *Meleagris gallopavo* and *Parapavo californicus* but spur core more distally situated, less than 40 per cent of length of tarsometatarsus from distal end rather than 41 per cent or greater as in *Meleagris* and *Parapavo*; spur core more medially directed, the angle with anterior surface of shaft less than 59 degrees rather than 62 degrees or greater as in *Meleagris gallopavo* and *Parapavo*. Size similar to *Parapavo californicus*.

Measurements.—Paratypes: total length from intercotylar tubercle through middle trochlea, 138.8 mm.; width across trochleae, 20.9 mm.; width across cotylae, 21.3 mm.; minimum mediolateral transverse diameter of shaft, 8.6 and 8.6 mm. Minimum mediolateral diameter of shaft of type, 8.6 mm.

Referred material.—Distal one-fourth of left tibiotarsus, no. 3174 Panhandle Plains Hist. Mus. This fragment represents a turkey of the same general size as that represented by the tarsometatarsi of *M. leopoldi*. No diagnostic features of specific or generic type are discernible in this part of this element. Because of size and presence in the same formation, no. 3174 is referred to *M. leopoldi*.

Comparative material.—*Parapavo*, 8 tarsometatarsi with complete spur cores from Pleistocene of Rancho la Brea (Univ. Calif. Mus. Paleo.). *Meleagris gallopavo*, 3 male tarsometatarsi with complete spur cores (Mus. Vert. Zool. no. 119,318; Loye Miller coll. nos. 921 and 2295). *Agriocharis ocellata*, 1 male without spur core (Mus. Vert. Zool. no. 129,318) and 1 male with complete spur core (Loye Miller coll. no. 1743).

The Cita Canyon turkey material was originally assigned to *Parapavo californicus* by Loye Miller (1937) on the basis of correspondence in "size, proportions, elevation of spur core, relative positions of the trochleae, the small intertrochlear foramen on the inner side, the shape of the proximal cotylae and hypotarsus, the incipient hypotarsal third ridge." Of these characters we now find that the elevation of the spur core is different and forms part of the basis for recognizing the Cita Canyon bird as a distinct species. The remaining characters do not now appear to be of service in separating the genera *Parapavo* and *Meleagris*. Size of the order here involved can not serve in generic distinctions as there are many size types among races and species in *Meleagris*. The proportions of length to width of the tarsometatarsus appear similar in the two genera (see Howard, 1927). In the relative position of the trochleae there is considerable overlap with *Meleagris*. The inconstant development of the intertrochlear foramen and

*Named in recognition of the contribution of A. Starker Leopold to the knowledge of the biology of modern turkeys.

the incipient hypotarsal third ridge in *Parapavo* and *M. gallopavo* has already been reported by Howard (*loc. cit.*) and is confirmed by us. We have found no character in the shape of the proximal cotylae which warrants

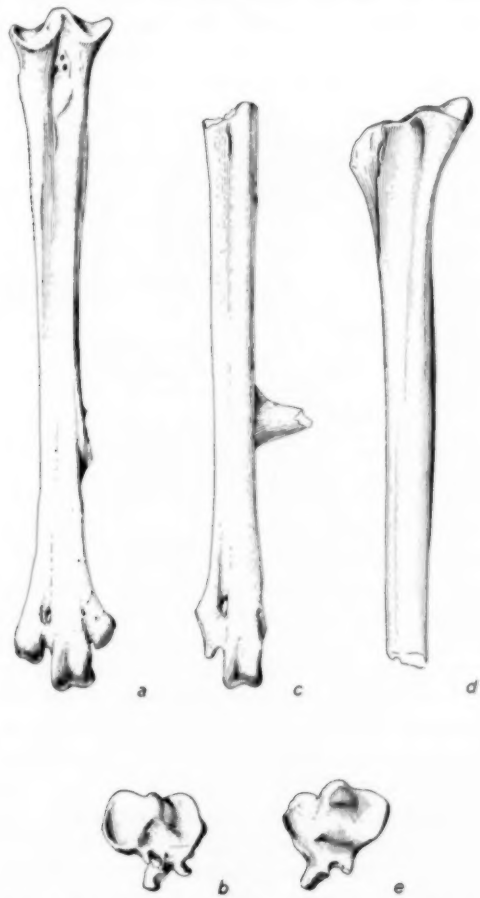

FIG. 1. Fossil birds from Cita Canyon, Texas; drawings by Owen Poe.

a, b, paratype of *Meleagris leopoldi*, anterior aspect and proximal articular surface, no. 3169, Panhandle Plains Hist. Mus.; **c**, type of *Meleagris leopoldi*, no. 45086, Univ. Calif. Mus. Paleo.; all × ¾.

d, e, type of *Plegadis gracilis*, medial aspect and proximal articular surface, no. 45088, Univ. Calif. Mus. Paleo.; both × 2.

confidence. Thus in none of these particulars nor in any other features of the tarsometatarsus do we find grounds for generic separation of *Parapavo* and *Meleagris*, although there appears to be justification for separation of these genera on the basis of differences in other skeletal elements, particularly the skull (Howard, *op. cit.*), and *Agriocharis* may similarly be separated.

TABLE 4
HEIGHT AND ANGLE OF SPUR CORE IN TURKEYS

Species	Height of spur core as per cent of total length of tarsometatarsus[1]				Angle of spur core[2]			
	No.	Range	Mean	SD	No.	Range	Mean	SD
M. leopoldi	1	–	39.8[3]		2	53.0–58.5		
Parapavo californicus	6	41.7–46.0	42.7	2.04	8	62.0–78.0	68.3	5.13
M. gallopavo	3	41.2–43.4	42.1	1.00	3	63.5–71.5	67.1	4.18
M. crassipes[4]	1	–	45	–	–	–	39	–
Agriocharis ocellata	1	–	36.0	–	–	–	–	–

[1]Height of spur core was measured from the mid-point of the base of spur core to the end of the middle trochlea.

[2]Angle of spur core was determined by preparing plaster casts of tarsometatarsi from moulds composed of gelatin-agar agar mixture. The cast was sectioned transversely through the main axis of the spur core. From a tracing of the outline of the section, the angle of the spur core was measured in the same manner as illustrated by L. Miller (1940).

[3]To obtain this figure, total length of tarsometatarsus was measured on the paratype, whereas height of spur core was measured on the type.

[4]*Fide* L. Miller (*loc. cit.*).

This situation means that there is no basis for the assignment of tarsi such as those from Cita Canyon to *Parapavo* in contradistinction to *Meleagris*. They could relate to either. In the absence of associated diagnostic skeletal elements, such as the skull, it would seem best to carry a species like *leopoldi* in the more inclusive genus *Meleagris* and thereby avoid any implication of special affinity with *Parapavo*. The tarsus of *Agriocharis* seems separable from both *Parapavo* and *Meleagris* on the basis of its slenderness, particularly across the trochleae.

Several fossil species of turkeys previously assigned to *Meleagris* seem to bear no close similarity to *leopoldi*. *M. crassipes* (L. Miller, 1940) from the Pleistocene of San Josecito Cave, Nuevo León, was a small, short-legged species with the spur core situated high, near the middle of the shaft and directed more medially even than in *leopoldi* (see Table 4). *Meleagris superba* from the Pleistocene of New Jersey and Pennsylvania was much longer legged than modern *M. gallopavo* and therefore not like the much smaller *leopoldi*, whereas *Meleagris richmondi* of the Pleistocene of California, based on a sternum, was only about half the size of *M. gallopavo*

and thus too small to be identical with *M. leopoldi*. *Meleagris tridens* of the Pleistocene of Florida had a very distinctive triple spur development. *Meleagris celer* from New Jersey, likewise of the Pleistocene, although much smaller than *superba*, with which Marsh compared it, falls in the general size range of *gallopavo*. On the basis of the tibiotarsus it was claimed (Marsh, 1872) to be slender legged but whether in fact it was so in relation to *gallopavo* and *M. leopoldi* is uncertain as Marsh's measurements of the shaft fall in the range of *gallopavo* as given by Howard (*loc. cit.*: 23). The critical parts of the tarsometatarsus on which *M. leopoldi* is based cannot be compared in *celer*. The latter may indeed prove to be identical with *gallopavo*. The much older *Meleagris antiqua* of the Oligocene of Colorado, although the size of a female *M. gallopavo*, is based on the distal end of the humerus and cannot be compared with *M. leopoldi*. It is not likely to be specifically identical with the late Pliocene and Pleistocene forms.

The particular interest in *Meleagris leopoldi* lies in the further representation through it of turkeys in the Pliocene. Wetmore (1944:98) reported *Meleagris gallopavo* from the Rexroad fauna of the Upper Pliocene of Kansas on the basis of a tibiotarsus; probably on the basis of this element alone *leopoldi* and *gallopavo* could not be differentiated. The meleagrid line had presumably appeared in the Oligocene and diverged by the Pleistocene to form at least two generic types *Meleagris* and *Parapavo*, and probably also *Agriocharis*, known only from the Recent. At least several species of turkeys, of whatever genus, existed in the late Pliocene and the Pleistocene, with a very considerable size range. *M. leopoldi* has no certain phyletic relation to any one of these, although it is close to several of them. Its distinctive location and angulation of the spur core alone set it off from previously known species.

Ecologic and Zoogeographic Considerations

The bird remains from Cita Canyon are of two ecologic types, a water bird assemblage and a terrestrial representative. The ibis (*Plegadis gracilis*), the teal (*Anas*), and the unidentified ciconiiform could have become entombed in any lacustrine situation or river channel pond even if of very limited extent. The turkey (*Meleagris leopoldi*) would have demanded an open woods or scrub cover if not a denser type of vegetation. The avifauna suggests, then, a mixture of woodland and open bordering terrain, with ponds and marshes present.

The very small ibis herein described suggests a fragment of an ibis of similar size previously mentioned as occurring in the Upper Pliocene of Kansas. The ibises as a group are of world-wide occurrence in equatorial and temperate latitudes and the teals are cosmopolitan.

The turkey, herein described as a new species, is now assigned to *Meleagris* rather than to *Parapavo* as formerly. The doubting of its generic affinity with the Pleistocene *Parapavo* leaves the latter restricted in known distribution to the coastal districts of California.

Literature Cited

Howard, H.
1927 A review of the fossil bird, *Parapavo californicus* (Miller), from the Pleistocene asphalt beds of Rancho La Brea. *Univ. Calif. Publ. Bull. Dept. Geol. Sci.*, 17:24–26.

Johnston, C. S., and D. E. Savage
1955 A survey of various late Cenozoic vertebrate faunas of the panhandle of Texas. Part 1. Introduction, description of localities, preliminary faunal lists. *Univ. Calif. Publ. Bull. Dept. Geol. Sci.*, 31:27–50.

Marsh, O. C.
1872 Notice of some new Tertiary and post-Tertiary birds. *Amer. Jour. Sci. and Arts, third ser.*, 104:261.

Miller, L.
1937 A Pliocene record of *Parapavo* from Texas. *Condor*, 39:229.
1940 A new Pleistocene turkey from Mexico. *Condor*, 42:154–156.

Peters, J. L.
1931 Check-list of birds of the world. Vol. 1. Cambridge; Harvard Univ. Press.

Wetmore, A.
1940 A check-list of the fossil birds of North America. *Smithsonian Misc. Coll.*, 99:1–81.
1944 Remains of birds from the Rexroad fauna of the Upper Pliocene of Kansas. *Univ. Kans. Sci. Bull.*, 30:92.
1955 The genus *Lophodytes* in the Pleistocene of Florida. *Condor*, 57:189.

Wood, H. E., R. W. Chaney, J. Clark, E. H. Colbert, G. L. Jepsen, J. B. Reeside, Jr., and C. Stock.
1941 Nomenclature and correlation of the North American continental Tertiary. *Bull. Geol. Soc. Amer.*, 52:1–48.

Museum of Vertebrate Zoology, Berkeley, California, June 1, 1955

MEASUREMENTS OF THE HABITAT NICHE OF THE LEAST FLYCATCHER

BY W. J. BRECKENRIDGE

EXACT measurements of habitat niches occupied by higher animals, particularly birds, have been difficult to make and few have been reported. During a recent six-year study of the breeding birds of an upland oak habitat, opportunity arose to measure certain elements influencing the distribution of Least Flycatchers (*Empidonax minimus*). A 20-acre study plot had been chosen for the study since it appeared to be homogeneous habitat. A population of about 60 pairs of Least Flycatchers per 100 acres nested in the area. Year after year these birds were recorded as occupying one particular half of this tract almost exclusively. Obviously some rather subtle environmental differences were influencing the birds' choices of nesting sites. For this reason, an analysis of the habitat was undertaken.

The study-tract lies about 35 miles north of Minneapolis, Minnesota, and within the limits of the University of Minnesota-owned Cedar Creek Research Forest. The dominant tree of the plot was the northern pin oak (*Quercus ellipsoidalis*). A few bur oaks (*Q. macrocarpa*) and some jack pines (*Pinus banksiana*) were scattered throughout the area. A few large white pines (*Pinus strobus*) and a small number of white birch (*Betula papyrifera*) and red maple (*Acer rubrum*) trees occurred. The height of the overstory was mostly 40 to 50 feet with an occasional northern pin oak and some of the white and jack pines rising to 70 feet. Here and there one or a few of the scattered dead trees had blown down causing small openings in the forest crown. The shrub story was made up largely of young oaks, Juneberries (*Amelanchier* sp.), wild cherries (*Prunus serotina* and *P. virginiana*), red maple (*Acer rubrum*) and hazel (*Corylus americana*). This layer varied in abundance, being denser under the openings in the forest crown. The ground cover varied from sparse to moderate with two species of blueberries (*Vaccinium angustifolia* and *V. canadense*), bracken (*Pteridium aquilinum*), Solomon's seal (*Polygonatum canaliculatum*) and wild sarsaparilla (*Aralia nudicaulis*) being common along with a sparse growth of grasses and sedges.

In this study area the Least Flycatcher nested almost invariably from 10 to 30 feet above the ground in vertical forks of small trees. Its territories were small, usually less than one acre in extent, and were of the type wherein courtship, nesting, and the feeding of the nestlings all took place within these narrow limits. The feeding birds darted out from convenient lookout perches to capture prey, then alighted on another perch, and another and another in succession as they circulated throughout their territories. Singing continued throughout their feeding periods. The estimated heights in feet of

29 successive perches used by an individual flycatcher were recorded on July 9, 1954. The extremes in this particular series, 8 and 35 feet, are representative of what had been observed for other individuals over the years. This stratum used by the Least Flycatchers extended vertically from the top of the shrub stratum up to the leafy canopy of the forest overstory.

Figure 1 is a copy of the map of the area used in recording field observations. The numbers appearing in the half-acre plots represent the total recorded observations of the Least Flycatcher for each plot as recorded in the regular breeding-bird censuses of 1948 through 1954 (1953 excepted). Since these are based on over 108 hours of observation extending over six years, during which time all species were being recorded and all parts of the tract receiving similar attention, it is assumed that these figures represent an unbiased, numerical evaluation of the amount of use made by the birds

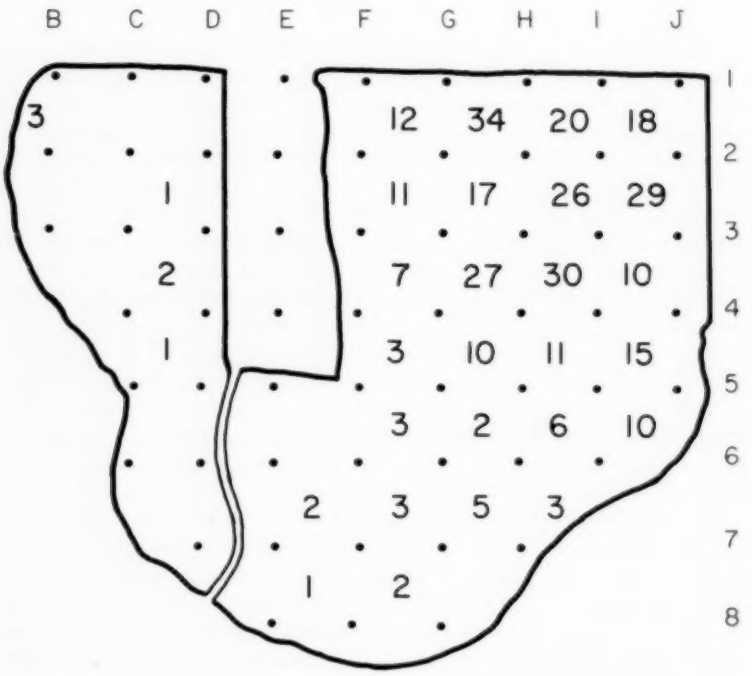

FIG. 1. Map of the Least Flycatcher census area. Numbers on the half-acre plots record the numbers of observations as indicating use of that portion of the habitat by flycatchers during six years of censusing on this 20-acre area.

TABLE 1

NUMBERS OF TREES AND HAZEL SHRUBS ON STUDY PLOTS

	Heavy Use		Moderate Use		Little or No Use	
Plot Number	G34 H34	H23 I23	F23 G23	G45 H45	C34 D34	E56 F56
Use by Birds[1]	27	26	11	10	2	0
N. Pin Oak	129	115	109	168	230	272
Bur Oak	32	19	34	18	6	3
Jack Pine	15	44	66	2	0	18
White Pine	1	1	1	0	3	2
White Birch	2	7	0	0	12	0
Total Trees	179	186	210	188	251	295
	356		398		546	
Hazel 3 ft. 6 in. or larger	477	1982	858	198	45	31

[1]Values refer to numbers of observations plotted in Figure 1.

of the various half-acre plots. This pattern of use was essentially the same during each of the six seasons of the study.

Several possible elements of the environment were studied in sample plots to ascertain which might be correlated with flycatcher use. First, it seemed reasonable to suspect that the abundance of certain species of trees (1-inch DBH and larger) or shrubs was influencing the birds. Accordingly, a census was made of the trees and shrubs in six half-acre plots, two each in the little-used, moderately-used, and heavily-used areas (Table 1). Of the forest tree species present, only the northern pin oak, bur oak, and jack pine were sufficiently abundant to influence habitat selection. The least-used plots definitely had the least number of bur oaks but no difference existed between the numbers of these oaks in the moderately- and heavily-used areas. Variation existed in the numbers of jack pines present but in no way were these correlated with flycatcher use. The numbers of the dominant northern pin oaks varied inversely with the use by the flycatchers when total numbers for each pair of the three areas classified according to use were considered: 244 in the two heavy-use plots, 277 in the two moderate-use plots, and 502 in the two little-use plots. However, marked discrepancies in this relationship between individual plots indicated that this probably was not the critical element influencing flycatcher behavior.

A census of trees in different size classes was then undertaken (Table 2). The numbers in the two larger size classes showed no variation which correlated with flycatcher use. In the two smaller classes, the plots with the most trees had the least use by the birds, but these figures do not differentiate between moderate- and heavy-use areas.

It was noticed that the growth of hazel varied between different plots. William Hsuing's ecological study of an allied species, the beaked hazel, *Corylus cornuta*, (1951. Unpubl. thesis, Univ. Minnesota Library) showed

TABLE 2
NUMBERS OF TREES ON STUDY PLOTS
ENUMERATED BY SIZE GROUPS (DIAMETER BREAST HIGH)

Plot	Trees 1 to 2⅞ in.		Trees 3 to 6⅞ in.		Trees 7 to 9⅞ in.		Trees Over 10 in.		Totals	
G3/4 H3/4	44	86	81	152	40	97	14	30	179	378
Heavy Use H2/3 I2/3	42		71		57		16		186	
F2/3 G2/3	48	102	80	148	66	107	16	41	210	407
Mod. Use G4/5 H4/5	54		68		41		25		188	
E5/6 F5/6	130	204	106	226	44	91	15	25	295	548
Little Use C3/4 D3/4	74		120		47		10		251	

that the growth usually increases with the increased light resulting from openings in the forest crown. Accordingly, counts were made of the hazel stalks 3½ feet high or higher in six representative half-acre plots (Table 1). The total numbers of hazel plants in the three use classes varied directly with flycatcher use.

However, one plot used moderately had nearly twice as much hazel (858) as did one of the plots having heavy use (477). This result suggested that the degree of closure of the forest crown was related to flycatcher use but again this measurement did not differentiate between medium- and heavy-use areas.

Examination of the varying conditions in this habitat finally suggested that the real limiting factor was the degree of openness just beneath the forest crown; in other words, the abundance and distribution of limbs intersecting the zone of use of the flycatchers (8 to 30 feet in height) beneath the leafy forest canopy. The technique devised to measure this condition was to elevate to various heights a closed umbrella frame which was then opened to 42 inches in diameter and a record made of whether it did (+) or did not (—) touch a branch in opening. This was accomplished with the use of a sectional bamboo pole with control strings for opening the umbrella frame. Readings were made at four different levels (8, 15, 20, and 25 feet) and these measurements were repeated at five-step intervals along six or seven string-marked lines intersecting each half-acre plot, making 264 or 308 readings on each plot. Six plots were so measured (Table 3), two plots each representing the little-used, moderately-used and heavily-used areas. In this table the percentage of openings of the testing frame in which no obstructions were encountered is designated as the percentage of openness.

In this series the percentage of openness is correlated directly with flycatcher use to a surprising degree.

TABLE 3

MEASUREMENTS OF THE FREQUENCY OF OPEN SPACES IN THE BRANCHES BENEATH THE FOREST CANOPY

Plot Number	Little used		Moderately used		Heavily used	
	E56 F56	C34 D34	G45 H45	F23 G23	G34 H34	G12 H12
No. Flycatcher Observations	0	2	10	11	27	34
No. Readings	264	308	264	308	308	308
Percent of Openness	26.5	23.4	36.4	37.0	45.1	48.7

It thus appears that limb density in a forest habitat is a critical factor in limiting its use by Least Flycatchers and that the density threshold beyond which the habitat became unsuited to their use was reached within the narrow limits existing in this study tract.

Pertinent to this study of the nesting territory of the Least Flycatcher is the observation that far higher populations of 200 and 271 pairs per 100 acres were recorded by MacQueen (1950. *Wilson Bull.*, 62:194–205) in two seasons' study at the Michigan Biological Station at Douglas Lake, Michigan. Her description of the environment is similar to that of this study but involved different species of trees, and included more small openings. This Douglas Lake habitat probably represents more nearly the optimum for this flycatcher, since no denser populations have been reported. Habitats more open than that at Douglas Lake would doubtless support smaller populations and would represent the approach toward the opposite (more open) limb density threshold from the one dealt with in the present study. MacQueen states that in a more closed type of forest near the station 60 pairs per 100 acres were found. This latter habitat (presumably with denser branching beneath the canopy) probably more nearly resembled the habitat in this study and correspondingly it had a comparable Least Flycatcher population.

Furthermore, it is probable that the territories of birds such as these can be measured better in three dimensions rather than in two. In this connection, the observation of Saunders (1936. *New York State Mus. Handb.* No. 16) that orchards commonly attracted small populations of these flycatchers (12 pairs per 100 acres) appears to bear out this suggestion. The low growth form of orchard trees reduces the vertical dimension of the canopied habitat, forcing the birds to extend their territories horizontally to secure the same cubic content of favorable habitat.

UNIVERSITY OF MINNESOTA MUSEUM OF NATURAL HISTORY, MINNEAPOLIS, MINNESOTA, JULY 18, 1955

THE ROCK PTARMIGAN IN SOUTHERN BAFFIN ISLAND

BY GEORGE M. SUTTON AND DAVID F. PARMELEE

In his discussion of the local distribution of land birds along the south coast of Baffin Island, Soper (1940:15) names the Rock Ptarmigan (*Lagopus mutus*) among the "common residents" of grass-tundra districts "interspersed with rocky ridges." He includes the Snow Bunting (*Plectrophenax nivalis*), Water-Pipit (*Anthus spinoletta*) and Horned Lark (*Eremophila alpestris*) in the same category, and says of the four species: "They are invariably associated with granitic areas and are therefore absent in the wide, swampy tundras, except for sporadic companies during migration. Where isolated granite ridges protrude from these plains . . . a few pairs will be found nesting." In a more recent paper (1946:225), this author calls *Lagopus mutus* "one of the most characteristic land birds of southern Baffin Island."

In the summer of 1953 we found the Rock Ptarmigan decidedly rare about the head of Frobisher Bay, Baffin Island. Our headquarters were at Lat. 63° 45′ N., Long. 68° 33′ W., at a Royal Canadian Air Force Base. We covered an area of 18 square miles near the Base by foot fairly regularly. Much of this area was "desert tundra," and birdlife was scarce. A very few pairs of Rock Ptarmigan nested there. At the mouth of the Jordan River, 16 miles west of the Base, we failed to see a Rock Ptarmigan on either of our two visits (July 13; July 17–20). Most of our time there we spent in meadow tundra near the river, not in the rough country farther west. We did not see the bird on Hill Island, Bishop Island, or any of several other islands at the head of the Bay. At Lat. 68° 31′ N., Long. 71° 22′ W., near a large lake about 50 miles east-northeast of Wordie Bay, we did not see the species on August 8. At Lat. 65° 20′ N., Long. 77° 10′ W., near Cape Dorchester, we saw both adults and young on August 11 and collected two adult males that day. At Lat. 63° 38′ N., 70° 28′ W., along the southeast shore of Lake Amadjuak, we saw no Rock Ptarmigan on August 8 but saw literally hundreds of them on August 15. Some sort of migration must have been taking place, although we witnessed no such migration anywhere about the head of Frobisher Bay.

From June 15 to 22 we looked in vain for a ptarmigan in the vicinity of the Base. Daily we came upon evidence that the birds had inhabited the region — recently molted white body feathers; parts of carcasses, principally wings, with white primaries still attached; and droppings. A wing found June 15 looked as if the flesh had been picked from the bones only a week or so before.

On June 21, civilian workmen told us that for some time they had been seeing a pair of "partridges" in high, rough country near a construction

road a mile or so north of the Base. Describing the cock as white, the hen as grey, they said that "just recently" they had not been seeing the hen, so had assumed that she was on her nest. The cock they had been seeing daily.

Early the following morning we found a white male ptarmigan, almost certainly this very bird. He was standing motionless on a huge rock. He gave a low cackle, otherwise we might never have seen him. Despite his being in almost complete winter plumage he was anything but conspicuous, for his white feathers were badly soiled, probably by dust from the much-used road. The red combs above his eyes were scarcely visible, but dark summer feathers spotted his head and upper neck. This was the latest date on which we saw a male ptarmigan largely in winter feather. Soper (1928: 105) informs us that in the Nettilling Lake area in 1925 "male birds remained white until well into July." At the head of Clyde Inlet in 1950, Wynne-Edwards (1952:366) saw a male with "dark feathers only on the crown and nape, and a spot on the breast" as late as June 23. In the Kotzebue Sound area of Alaska, on May 28, 1899, Grinnell (1900:36) collected males "in entire winter plumage" except for a few new dark feathers hidden among the old white crown feathers. Along the base of Wales Mountain, in northwestern Alaska, on June 5, 1921, Bailey (1926:123) took a courting male which was "entirely white except for the black loral patch." Delay of the male bird's molt into summer feather is described in detail by Salomonsen (1939).

We never saw this male ptarmigan again. We later found a female and her brood in this same area, but no male was with them. Salomonsen (1939: 417–418) says that in "the latter part of the brooding-time the male will retire to the higher parts of the mountain, where it lives alone the entire summer. The female . . . takes care of the newly hatched young, but when the juveniles are medium-sized it will fly with them higher up the slopes, joining the male, and from now on the . . . family will stick together." Jourdain (in Witherby, *et al.*, 1948:230) says that where ptarmigan are "plentiful, males generally desert broods and join in packs."

On July 6, in high country six or seven miles northeast of the Base, we happened upon a mother ptarmigan and her recently hatched brood. Having found the nest of a Snowy Owl (*Nyctea scandiaca*) along a little stream, we were crossing a rocky ridge. The day had lost its sun and hard snow was falling. The owls had been hooting and diving at us so fiercely that we had been forced to pay attention to them. Now that we were no longer being attacked, we were experiencing the rare sensation of being in owl habitat without either seeing or hearing owls. Suddenly, as we stepped down out of the wind into a sort of gully, we heard a rattling *grrr* or *krrr*

and there, about 15 feet away, was a female ptarmigan running rapidly off with head held low. Standing still while the ptarmigan scurried about, we heard cheeping and saw several chicks scrambling clumsily through the tough strands of heather (*Cassiope tetragona*). We counted nine chicks and set about catching them. Soon we had five, one of which we lifted from water; then a sixth, which had dropped into a foot-deep crevice; finally a seventh, which had crouched among coarse lichens on a rock. The chicks we failed to find must have cheeped from somewhere behind us, for the mother bird ran a few steps in that direction, flew swiftly upslope, alighted, then fluttered back in response to the outcry of the chicks we had captured. Salomonsen (1950:174) discusses at some length "injury feigning" of the mother ptarmigan while the chicks are small, and "distraction by running" after the chicks have begun to fly. What we have just reported clearly shows that running may at times be the "diversionary display" of a hen with very small chicks, and we regard as somewhat finespun and over-complex Salomonsen's statement that the "change . . . from injury-feigning to distraction by running is correlated with physiological alterations, viz. an activation of the feather-growth, the achievement of the autumn-plumage now starting, *i.e.*, a fortnight later than in the male."

The chicks were in the creel we used for carrying specimens. We put them on the ground and covered them with our hands, thus quieting them. The agitated mother came closer. Her crest was lifted, but her body plumage was pressed down tightly so she had a slender, long-necked appearance. She gave two callnotes — the throaty *krrr* just referred to, and a clucking *kit* or *krit*, which made the chicks restless. Wanting to take photographs, we decided on a procedure. One of us was to cover the chicks with his hands until the camera was ready; then, when the female came close and called *krit*, the chicks were to be freed. We did not let all the chicks go at once. When two of them ran to their mother she stood perfectly still, lifted her plumage, and became broody. One by one the rest of the chicks pushed their way under her, and we took photographs at a distance of two or three feet (Fig. 1).

The mother ptarmigan was in virtually complete summer feather. Her wings were largely white, of course, and there were many pure white feathers on her belly and lower breast. Whether these white belly feathers were of the outgoing winter plumage or part of the summer plumage we could not be sure. From the appearance of midsummer adult Rock Ptarmigan specimens we have handled, and from certain illustrations in Salomonsen (1939), we are led to suspect that some white belly feathers are replaced, season after season, in both males and females, with *white* feathers — in other words that the lower belly stays white the year round, just as the remiges do.

We looked in vain for the male bird. Wondering why this particular spot had attracted the ptarmigan, we noticed that no owls were in sight and wondered if we were in an area removed from, or between, the nest-territories and hunting-grounds of the owls. Many owls lived in the vicinity. That these birds were subsisting chiefly on lemmings was becoming more evident to us with every visit we made to their nests. Was this "ptarmigan area" uninhabited by lemmings and therefore unattractive to the owls?

FIG. 1. Female Rock Ptarmigan brooding chicks. Photographed near head of Frobisher Bay, Baffin Island, July 6, 1953.

We did not kill that mother bird, but we collected the largest and smallest of the chicks (GMS 11741–42). These proved to be, respectively, a male and a female. Their crops and gizzards were well filled with tiny green leaves of crowberry (*Empetrum*) and bits of sand.

The brood could not have been more than a few hours old. So little developed were the incoming primaries that we had to part the natal down of the manus to find them at all. Jourdain (in Witherby, *et al.*, 1948:230) states that in the Scottish Rock Ptarmigan (*Lagopus mutus millaisi*) the eggs are laid "at intervals of 24 to 28 hours," and the incubation period is 24–26

days; so egg-laying in this case probably started not later than June 3 or 4. On that date there must have been much snow in the high country. Soper (1946:225) found fresh eggs as late as June 28 in the Bowman Bay area in 1929.

On July 8 men at the Base told us of having seen that day a mother ptarmigan and several small young not far from the spot at which we had seen the solitary male July 6. On July 11 we learned that this (or another) hen and her chicks had just been seen in the same place, but we failed to find them. These chicks and the July 6 brood must all have hatched at about the same time. The two areas were about four miles apart.

On July 21, Derry V. Ellis reported that he had just seen a male, female, and at least four young ptarmigan in rough country about two miles east of the Base — between the Hudson's Bay Company post and Tarr Inlet, and not far from the sea. The chicks, about one-third grown, could fly well. Salomonsen (1950:174), discussing the "return of the male" to the female and brood in Greenland, reports "both parents in the covey as early as 28 July . . ." and "hens and chickens without the male" as late as August 25. We have no way of knowing, of course, whether the male seen by Ellis had left the female and brood at all.

On July 22, guided by Ellis, we found this family group about a quarter of a mile from the spot at which Ellis had last seen them. There were five young. The male flew upslope rapidly, alighting a few rods from us. The female beat her ragged wings briefly and noisily, as if trying to fly, but after rising a short distance dropped back to the ground. The young birds all flew well. We collected the adult male and female (GMS 11782–83) and three of the young, one male and two females (GMS 11784, –85, –86). The parent birds were largely white on the belly and lower breast. The male weighed 1 lb., 1 oz., the female, 14 oz. The testes of the male each measured about 3 × 5 mm. The female had a large, but ill-defined, brood-patch. The crop and gizzard of each of the five specimens was crammed with leaves, stems, buds, green berries, and gravel.

The young birds were still partly in natal down. The white of their incoming remiges was not yet noticeable. From Bent's statement (1932:207) one might expect to find two white outer primaries in chicks at this stage. Actually, as Salomonsen (1939:50) carefully explains, the two white outermost primaries "commence to grow much later than" the other juvenal remiges; they do not reach full length until most or all of the brown juvenal primaries have dropped out; and they may not be part of the juvenal plumage at all. In the three young birds collected by us July 4, the *functional* outermost primaries were dark and brown, but the actual outermost two, mere tips and utterly non-functional, were barely visible. These

incoming feathers were white, but there was dusky mottling along the midrib. In each chick one or more proximal primaries, or distal secondaries, or both, were pure white. These were, though very short, visible when the wing was fully spread.

We had no way of knowing, of course, where these ptarmigan had nested, but the area in which we found them was far removed from our other two "ptarmigan areas"; it was, furthermore, the only area in which we found the Short-tailed Weasel (*Mustela erminea*), the only area in which we actually saw the Arctic Hare (*Lepus arcticus*), and one of the very few areas visited by us in which we never saw a Snowy Owl.

On July 22, Derry Ellis saw another "dark" adult ptarmigan, probably a male, on a bluff headland just west of Tarr Inlet. This bird we looked for but did not find.

On July 26 we found a female ptarmigan and six half-grown chicks in high country north of the Base. These birds were feeding contentedly on the lee side of a rocky hill not far above a big lake. The mother bird stood on a rock not far away — motionless until we drew close, whereupon she walked a few steps, flicking her tail excitedly. The brood kept together, moving slowly in the same general direction and pulling the greenery off with rapid jerks of their heads. They were somewhat older than the chicks we had seen on July 22, a fact apparent from their size as well as from the noticeable amount of white showing in their wings as they took flight. Every chick had this white wing-spot. The functional outer primaries were dark, the wing-spot being composed of inner primaries (and outer secondaries?). The mother bird, though in full summer feather, was white-bellied. Her rump was not, so far as we could tell, a mixture of coarsely- and finely-marked feathers, so she probably had not yet started to don "fall" plumage. Her wings were ragged with molt, but she flew fairly well.

On July 28, on a talus slope just above the raised beach paralleling the shore of Tarr Inlet, Parmelee flushed a pair of ptarmigan at about 20 feet. He followed and collected the male (GMS 11793), a handsome gray individual, white on the belly, throughout most of the wings, and in the middle of the throat. The combs above the eyes, though not large, were bright red. The testes each measured about 3.5 × 5 mm. The crop and gizzard were packed with broken-up leaves, twigs, and buds of willow (*Salix* sp.) and birch (*Betula* sp.).

On August 3, while climbing a steep, boulder-strewn slope just east of Tarr Inlet, we noticed among the unusually luxuriant birch and willow a great deal of ptarmigan sign — fresh droppings, scattered white feathers, nipped-off twigs, and, finally, a few buff-and-black summer feathers. We looked hard for the birds but failed to find them. That afternoon Sutton

returned, investigated the windless places, and found a group of four birds, an adult female and three young, all very tame. Motionless for a time, they came suddenly to life, lifted their heads, pressed their body plumage close, and flicked their tails, as if about to fly, but presently they returned to "normal" and walked slowly to one side. The chicks were almost as large as the adult.

Sutton collected the adult female (GMS 11802) and the largest chick (GMS 11803), a male. Both were molting, the chick extensively. The chick's combs were a brighter shade of red than the adult's, and its two outermost primaries, white except for dusky mottling along the rachis near the tip, were still sheathed at the base. The primary next to these two was brown, and this was the only dark primary left (see Figure 2). The incoming plumage on the sides was pure white; but the body plumage is general was much mottled and barred. The testes measured about 2 × 3 mm. The crop and gizzard in both specimens were packed with willow leaves and other vegetation.

FIG. 2. Young male Rock Ptarmigan collected near head of Frobisher Bay, Baffin Island, August 3, 1953 (GMS 11803). Note the one unmolted brown juvenal primary among the white first-winter primaries.

On August 10 workmen saw a female ptarmigan and nine large young in high country about a mile north of the Base. This could hardly have been the brood seen by us on July 26. We tried to find the birds, but failed. We did not see a ptarmigan anywhere about the head of Frobisher Bay after August 3.

On August 11 we saw several Rock Ptarmigan in the vicinity of Cape Dorchester, near the northwest tip of Foxe Peninsula, an area in which we

had fully expected to find the Willow Ptarmigan (*Lagopus lagopus*) if we found any ptarmigan at all. The country there was much flatter than that about the Base; but just east of the lake-dotted meadow tundra rose several parallel rocky ridges, all low, all extending from the coast to as far southward and inland as the eye could see. Near them, but definitely away from them, out in the grassland, we found several Rock Ptarmigan — first a female and five quarter-grown young; then two adult males feeding together fully three hundred yards from the nearest rocks; then two more adult males. We collected an adult male (GMS 11828) among the rocks and another adult male (GMS 11829) on the tundra. The former we almost certainly would never have seen had it not given a dry, rattling, belch-like cry. The two specimens were very gray, but in both of them the white feathers of the belly, tibiae, tarsi and toes were largely of the *incoming* winter plumage, so the darkest stage of the fall or late summer plumage must surely have passed. The undertail coverts were very dark. These birds were not very fat. Their testes each measured about 3 × 5 mm.

Along the southeast shore of Lake Amadjuak, on August 15, again in country throughout which we expected to find Willow Ptarmigan, we came upon great flocks of Rock Ptarmigan — most of the birds undersized and young, all in mixed, piebald plumage. They were feeding on the rough, rocky slopes rather than in the grasslands. Not a bird did we see along the lakeshore proper or in a marshy place near a tundra pond. In one flock were several one-third grown young with their solicitous mother, whose cries were unlike those of the other adult birds. In one area fairly swarming with ptarmigan the rattling or cackling was an almost continuous sound. The wind was high and the birds were restless. More than once, in the lee of a hill, we flushed a hundred or so birds at a time and the air was filled with the flashing of white wings. In this country there were many Barren Ground Caribou (*Rangifer arcticus*). We were amused when several of these fine animals, having put the ptarmigan to flight by suddenly breaking into a run, themselves were startled by the whirring and flashing of wings beneath their feet.

We collected an adult male ptarmigan (GMS 11839) which seemed to keep separate from the flocks. This bird was gray, but throughout its body plumage were scattered new white feathers. The testes each measured about 3 × 5 mm.

Nesting Success

We saw, or heard of, the following broods: 9 small chicks (July 6), "several" small chicks (July 8), 5 third-grown chicks (July 22), 6 half-grown chicks (July 26), 3 almost full-grown chicks (August 3), 9 "large" chicks (August 10), 5 quarter-grown chicks (August 11), and "several"

third-grown chicks (August 15). The last two broods must have been unusually late in hatching. One pair of adults, seen July 28, were without chicks. The big flocks seen by us August 15 were composed largely of well-developed young birds which seemed to be free of "family ties."

We found no evidence that Snowy Owls nesting near the Base were feeding on ptarmigan. We visited several owl nests quite regularly, carefully examining them and their surroundings at each visit.

Factors favoring the ptarmigan in the vicinity of the Base were (1) absence of the Arctic Fox (*Alopex lagopus*); (2) great rarity of weasels; (3) abundance of lemmings (*Dicrostonyx groenlandicus* and *Lemmus trimucronatus*), the sole prey of the Snowy Owl and Rough-legged Hawk (*Buteo lagopus*), so far as we could ascertain, and an important food-item of the Peregrine (*Falco peregrinus*); (4) absence of jaegers (*Stercorarius* spp.); (5) rarity of the Glaucous Gull (*Larus hyperboreus*) and Herring Gull (*L. argentatus*); (6) an artificial food supply for the Raven (*Corvus corax*) at the Base's dump.

The personnel at the Base did little, if any, gunning. The Eskimos occasionally shot a ptarmigan, we were told, but they did not shoot any during our stay.

Discussion of Specimens

Our five adult male specimens do not, when lined up in order of capture, show gradual change from "early summer" to "late summer" plumage (Fig. 3). The earliest (July 22) is certainly the most coarsely marked above, especially on the crown, neck, rump and upper tail coverts, but the general appearance of the back is not dissimilar to that of the latest (August 15). The under parts of these two specimens are similar, too, though the white of the July specimen seems to be composed wholly of outgoing feathers, while in the August specimen all these white feathers are new. In only one specimen of the five (July 28) is the middle of the throat noticeably white. In no specimen is the lower belly anything but white. The under tail coverts, throughout the series, are very dark.

Of the two adult females, the earlier (July 22) is decidedly the more boldly marked above, and the under parts of this bird have a blotchy appearance resulting from the presence of numerous unmolted winter feathers. In the August specimen many of the back and rump feathers, scapulars, and upper tail coverts are of the finely vermiculated "late summer" plumage, and the under parts, save for the white of the very middle of the lower belly, are boldly maculate.

The almost full-grown male (August 3) is decidedly like the adult female taken the same day in some respects, an interesting point of similarity being the dusky mottling along the midrib near the tip of the longest primary

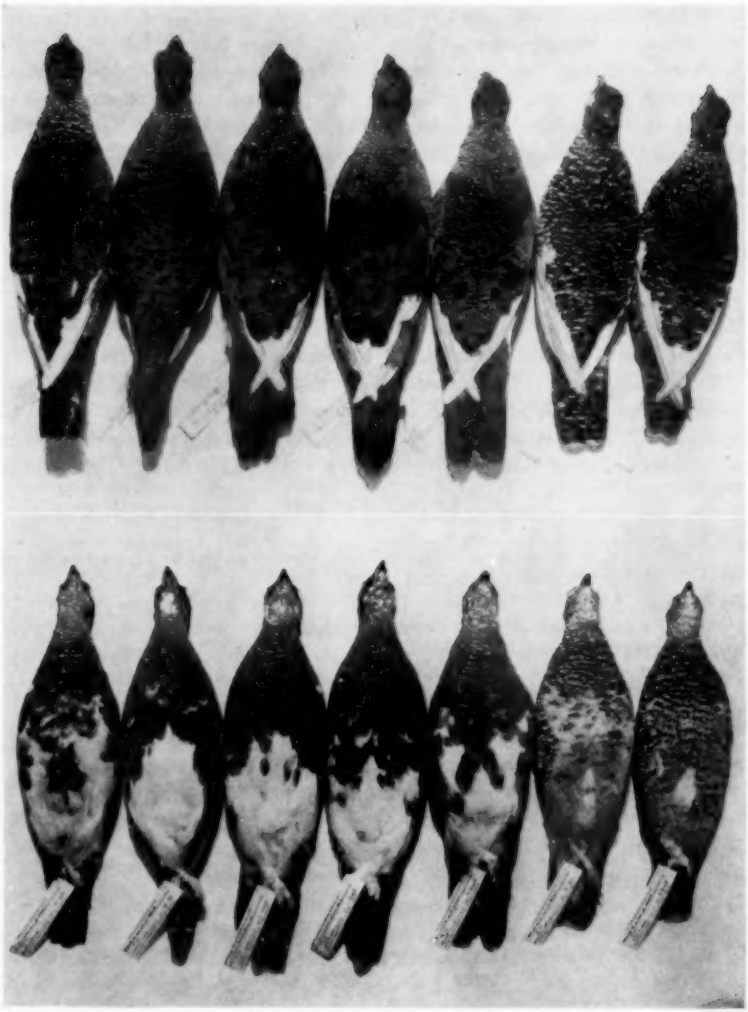

FIG. 3. Dorsal (above) and ventral views of five adult male (left) and two adult female Rock Ptarmigan specimens from southern Baffin Island, arranged in order of capture. Males, left to right: GMS Nos. 11782 (July 22), 11793 (July 28), 11828 (Aug. 11), 11829 (Aug. 11), 11839 (Aug. 15). Females, left to right: GMS Nos. 11783 (July 22), 11802 (Aug. 3).

(see Figure 2). Worth mentioning is the possibility that these primaries are equal or correspondent — that in the female having been held over from the preceding fall, and showing her to be a one-year-old bird, that in the young male being one of its two very first outermost primaries. The outermost primaries of adults more than a year old probably are without this dusky mottling.

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Literature Cited

Bailey, A. M.
1926 A report on the birds of northwestern Alaska and regions adjacent to Bering Strait. Part 9. *Condor*, 28:121–126.

Bent, A. C.
1932 Life histories of North American gallinaceous birds. *U. S. Nat. Mus. Bull.* 162:1–490.

Grinnell, J.
1900 Birds of the Kotzebue Sound region, Alaska. *Pac. Coast Avif.* no. 1:1–80.

Salomonsen, F.
1939 Moults and sequence of plumages in the rock ptarmigan (*Lagopus mutus* [Montin]). *Vidensk. Medd. Dansk Naturhist. Foren.*, 103:1–491.
1950–51 The birds of Greenland. (Copenhagen.) Pt. 1: 5–158 (1950); pt. 2: 159–348 (1951); pt. 3: 349–608 (1951).

Soper, J. D.
1928 A faunal investigation of southern Baffin Island. *Bull. Nat. Mus. Canada*, 53:76–116 (Birds).
1940 Local distribution of eastern Canadian arctic birds. *Auk*, 57:13–21.
1946 Ornithological results of the Baffin Island expeditions of 1928–1929 and 1930–1931, together with more recent records. *Auk*, 63:1–24, 223–239, 418–427.

Witherby, H. F., F. C. R. Jourdain, N. F. Ticehurst and B. W. Tucker
1948 The handbook of British birds. Fifth impression. Vol. 5:1–381.

Wynne-Edwards, V. C.
1952 Zoology of the Baird expedition. (1950). I. The birds observed in central and south-east Baffin Island. *Auk*, 69:353–391.

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WHAT CONSTITUTE SCIENTIFIC DATA FOR THE STUDY OF BIRD DISTRIBUTION?[1]

BY JOSSELYN VAN TYNE

THE student of bird distribution is now having placed before him not only far greater amounts, but also wholly new types, of data. Hence he will do well to occasionally stop and re-examine the materials with which he is constructing his account of bird distribution. If he were to fall into conversation with some of those zoologists who deal with mammals, reptiles, or amphibians, he would find that when they work out and map the distribution of a species they use only *specimen* records. If he were then to try to tell the mammalogist, for example, how much better we ornithologists do things, the mammalogist, if he knew his literature well, would surely read to him the following passage published in 1928 by Joseph Grinnell, probably the most distinguished student of bird distribution America has produced:

"With the great majority of the species of birds and mammals, of reptiles and amphibians, there is only one acceptable basis for determining presence and that is the taking of actual specimens and the preservation of these permanently, with attached, signed statements of locality and other circumstances of capture. So-called 'sight records,' even of the commonest birds, have proved over and over again to be wrong. Many, many species and subspecies are difficult enough of systematic determination with actual specimens in hand; especially is this true as regards the ultimate taxonomic unit, . . . the subspecies. The results of distributional study to be valid must be made on the basis of accurate identifications of materials; and these materials must be preserved so as to permit of repeated verification as refinements in systematic analysis accompany increased experience. Hence the research museum, functioning as the repository for this accumulating evidence. Popular testimony, impression, the sight record, have, perhaps, their place in the 'romance' of natural history; but this province belongs to literature and not to science." ("Presence and Absence of Animals," *University of California Chronicle*, 30, 1928:429–450. Reprinted in "Joseph Grinnell's Philosophy of Nature," 1943.)

Certainly these are sound principles to follow in dealing with most land vertebrates. For example, most mammals, reptiles, and amphibians are not meant (so to speak) to be identified at a distance, nor primarily by vision. They identify each other only at rather close range, and then mainly by scent or sound, neither of which can be received really well by man. Indeed

[1]Presented October 21, 1952, at the meeting of the American Ornithologists' Union at Baton Rouge, Louisiana. Those interested in this topic should not fail to read also Ludlow Griscom's excellent discussion in the *Proceedings of the Linnaean Society of New York*, Nos. 63–65, 1954:16–20.

some mammals cannot be positively identified even by the expert mammalogist until he examines the teeth with a dissecting microscope.

But we may be justified in treating birds somewhat differently from the way we treat other vertebrate groups. Birds, by and large, readily recognize each other at a distance, and primarily by vision. Man (if we include field glasses as "factory equipment") has finer vision than any other mammal and is therefore especially equipped to act as a bird among birds and to distinguish the various species at a distance. Further, the ornithologist has the advantage of what may be called the "Roger Peterson effect," for, thanks to Peterson, identification of birds in the field has become a science in itself.

Early in the century, before the era of scientific field-guides and good binoculars, the careful ornithologist was almost wholly restricted to the use of specimen records, but there has been a great change. The shift came slowly at first. Single notes by ornithologists of repute began to appear in the *Auk* and other major journals, reporting a sight record of some strikingly plumaged bird in a region where it had not previously been recorded. These notes were distinguished by their wealth of supporting detail. The author recorded how near the bird was and how long he watched it, adding that he had become familiar with the species elsewhere and that he was aware at the time of observation of the rarity of the occurrence. The permanent scientific value of the note was also safeguarded at every step in its preparation for publication. The note was sent to the editor, who probably returned it to the author at least once, calling his attention to ambiguities in expression and to certain details that it would be desirable o add. Then the note was returned to the editor, set in type, and the proof sent to the author for checking. When it finally appeared in print it was almost equal in value to a specimen record.

A major influence in the changing situation in American ornithology was the development of the "Season Report." Frank Chapman, who originated so many things in ornithology, introduced the "Season Report" in his popular journal, *Bird-Lore* (1917) in order, he stated, "to give a general idea of the more unusual features of each season in different parts of the country" and "to accumulate a valuable fund of data on the fluctuation in the abundance of species."

The contributors of the early reports were:

Boston region—Dr. Winsor Tyler
New York City region—Charles H. Rogers
Philadelphia region—Julian K. Potter
Washington, D.C., region—H. C. Oberholser
Oberlin region—Lynds Jones

Soon he added:

Denver region—Dr. W. H. Bergtold
Minnesota region—Dr. T. S. Roberts

The reports were brief (usually but half a page) and were based on the direct observations of these recognized ornithologists and the field workers they personally knew. (Potter, for example, would quote Witmer Stone, or Oberholser would quote a young man named Alexander Wetmore.)

The "Season Report" section of *Bird-Lore* was immediately popular. More regions were added, and regional editor followed regional editor. Much information valuable to ornithology was printed. Indeed, T. S. Roberts published his collected reports of 20 years in book form ("Logbook of Minnesota Bird Life," 1938).

The section grew so large that it had to be published separately as a supplement; and soon it became a separate journal, *Audubon Field Notes*, under the joint auspices of the National Audubon Society and the U.S. Fish and Wildlife Service. It is now a journal of over 300 pages to a volume and treats 19 different regions. Furthermore, the idea has so spread that we have "Season Reports" (under one name or another) in many State and other local bird journals.

These regional reports have—almost necessarily—come to be handled by an ever larger and ever shifting group of regional editors, who are not always the most critically minded scholars in the field. Further ,the editors (and, in turn, their contributors) are increasingly under pressure to work fast and get their records and summaries in before a prescribed deadline. (It approaches the pressure under which newspaper men work!) Records are rushed in, combined and summarized as quickly as possible, and hurried on to the central editor. There can be no submitting of printer's proof to contributors; nor, as a rule, any correspondence about even questionable records. The tendency is to go ahead and publish a given record "for what it is worth" (a defense I have actually heard many times!). Under such circumstances the record may be worth exactly zero; or, indeed, it may have a negative value, for it may seriously mislead the student of bird distribution. Worst of all, there is no way of distinguishing good records from bad, nor of correcting the mistaken records afterward. (Though a specimen record may involve an error in identification, the specimen remains as a basis for correction.)

Thus as the acceptance of the sight record became more general, safeguard after safeguard was dropped and the use of these sight records became less and less defensible from the point of view of scientific method.

Noting the number of patent errors appearing in print which related to my own immediate geographical area, and noting that other writers were

beginning to use these "records" in their serious publications, I began to wonder how the "Season Reports" should be treated—and indeed how the editors *intended* that they should be treated. Therefore I wrote some of the editors and asked in what light they themselves viewed these publications. I was dismayed to find that some editors had not even thought about the matter! Others cheerfully replied that these records they were putting in print were "scientific data" to be treated at their face value. However, I am glad to say that Mr. Chandler Robbins, the editor of the leading journal in this field, *Audubon Field Notes*, sent me a thoughtful, critical statement:

> "Regarding the scientific value of observations reported in *Audubon Field Notes*, I consider that they may safely be used collectively, but that individually each must be judged separately on the reputation of the observer. In many areas the compilers know most of their regular correspondents personally, and so they screen out dubious material before writing their reports. A few deletions on grounds of questionable validity are made in editing the reports in this office; and we make a practice of publishing all corrections that are brought to our attention (except for misspellings or typographical errors which do not alter the details of observations).
>
> "Obviously, when we publish thousands of observations each year without providing details of each, this material cannot be considered of equal scientific value with detailed records published in the *Auk*, *Condor* or *Wilson Bulletin*. However, since the observer's name is given with almost every occurrence, contemporary ornithologists interested in confirming any given record can get further details by corresponding with the regional editor, a local compiler, or the observer himself.
>
> "In summary, I would say that: (1) in mass, *Audubon Field Notes* records may be taken at face value; (2) individually, sight records should be evaluated either by the reputation of the observer, or through further inquiry; (3) I consider a report of a specimen record in *Audubon Field Notes* as on a par with a specimen record in the *Auk* as far as validity is concerned; (4) rarities on Christmas Bird Counts are open to more question than are unusual reports in the other issues" (quoted with Mr. Robbins' kind permission).

We then come to the question of what can be done to improve the general situation.

It is clear that we need a widespread revision of editorial criteria. And here I am referring not only to the "Season Report" category but to our general scientific literature on birds which appears in serial publications. Let me illustrate by mentioning a recent issue of a very excellent British bird journal. There we find under the heading, "American Pectoral Sand-

pipers in England in 1951," a half-page note with no author's name attached, giving the dates and places of five new "records" of the Pectoral Sandpiper (an extralimital species there) with no details whatever, nor even a statement whether the birds were collected or merely seen. In short, we have gone so far that we now even forget to state whether we are talking about sight records!

While we all recognize the great value of the "Season Report" as an irreplaceable record of the mass movements of birds and the fluctuations in their numbers, the scholarly investigator of bird distribution dares not rely on any individual record that appears there without checking it by correspondence and by using every other safeguard he can devise. In the meantime, editors can help ornithologists greatly by raising standards in every possible way and by so editing that the "Season Report" will deal more exclusively with the general population changes and movements, which it alone can trace and put on permanent record, and less with the individual sight record.

Museum of Zoology, University of Michigan, Ann Arbor, Michigan,
September 1, 1955

GENERAL NOTES

Incubating American Robin repels female Brown-headed Cowbird.—At my home in New Castle, Lawrence County, Pennsylvania, the House Sparrows (*Passer domesticus*) have half a dozen nests every year and Brown-headed Cowbirds (*Molothrus ater*) parasitize several of these nests regularly. There is also a Robin (*Turdus migratorius*) which regularly places her nests in the "S"-shaped offset of the conductor pipe draining the metal gutter at the front of the house. Thus, the nest is sheltered by the roof. By early July of 1954 she had raised one brood, made some repairs to the nest, completed her second clutch of three eggs, and begun to incubate them. The time of day had arrived one morning when she would normally leave her nest briefly for food, drink, and perhaps even a bath. I noticed she was turning her head in a peculiar way, and looking intently for a moment at something at a distance; then she would utter a barely audible "churrup."

Following the line of her gaze, I noticed a female cowbird stalking in the grass at the edge of the street about 30 yards away. I thought the latter was trying to stay out of sight behind a maple tree, but it was plain that it was watching the robin by slight turns of the head every few seconds. This continued for perhaps five minutes and may have been going on for some time before I noticed it.

Suddenly the robin took off across the street toward a small swamp. No sooner was she out of sight than the cowbird flew directly to the robin's nest, perched on the rim for an instant, and then settled down on the nest. At almost the same instant, I saw the robin returning at full speed, with beak outstretched and, when within ten feet or so, scolding vociferously. The cowbird started awkwardly from the nest and had barely taken to flight when the robin hit her with feet, breast, and beak. The cowbird lost altitude rapidly. The robin made a circle and attacked with such force that both birds fell to the ground. Then the robin with wing and beak beat the interloper ferociously while the cowbird seemed to have no notion of defense except for flight. Every time the cowbird tried to rise, the robin pummelled her back to earth. The scuffle continued as they moved further up the street until, after much running and jumping, the cowbird made her escape. The robin did not follow further, but continued to scream and scold before returning to her nest.

I traced the route of the battle and noticed numerous specks of blood on the green grass, and, to my surprise, a cowbird egg. This was warm when I touched it. I left it until the next day to see if the robin would break it, but nothing happened. I then carried it ostentatiously to a point under the nest. The robin watched the performance but did not disturb it and the egg remained there for three days and then disappeared from causes unknown.—Carl L. Leathers, *1004 North Jefferson Street, New Castle, Pennsylvania, May 3, 1955.*

Goose-behavior by a White Leghorn chick.—Six hours after leaving the shell, an African gosling (a domestic breed of the Swan Goose, *Anser cygnoides*) was placed in a brooder with half a dozen White Leghorn (*Gallus gallus*) chicks, all of which were between the ages of 18 and 24 hours. One week later, the gosling, together with one of the chicks, was removed from the group and the two were placed in a separate room where a large pen had been prepared for them. Originally, the chick had been kept with the gosling only to provide company, for this gosling gave vent to loud distress cries whenever left alone. The animals were visited by the observer several times each day.

Within one week after hatching, the gosling proved itself imprinted onto humans, the following-reaction being readily elicited. It did not appear to discriminate between different individuals, however, this ability not appearing until it was more than four weeks of age. The chick, in the meantime, had become imprinted upon the gosling, following it, "cheeping" loudly when prevented from following, and fluttering excitedly towards the gosling upon the latter's return after an absence. Initially, the goose showed no overt response to this behavior of the chick, but by the middle of the second week it was apparent that the goose was reluctant to leave its pen to follow its human *Kumpan* unless the chick was permitted to accompany it. The gosling clearly showed ambivalence, following, stopping when the chick's "peeps" reached a crescendo, ofttimes returning to the chick, then following again. By starting the gosling off at a run or very rapid walk, this ambivalence could be overcome. Apparently, the inertia of a more rapid movement overcame the attraction of the chick's distress calls.

At this time, it was noted that the chick was adopting many of the behavioral traits of the goose. When the goose was treated to a handful of freshly cut grass, the chick would join it in pulling the grass from the observer's hands, eating it as eagerly as its Anserine partner. At first, the chick's efforts to manipulate large blades of grass were rather ridiculous, but it soon achieved considerable skill. In addition, the vocalizations of the chick began differing radically from what they had been earlier and from those of normally-reared chicks. Ordinarily, even when reared in isolation, the conversational sounds of chicks when feeding consist of a series of rather short, discrete "pips." In contrast, young goslings emit much softer notes which are run together to a much greater degree. The tone-quality of the chick's voice was not greatly altered, but the phraseology and modulation were clearly that of the gosling. (A tape recording has been made.)

This chick has not, it may be noted, progressed to the stage where it voluntarily will join the gosling in the latter's swim-tub. Regularly, however, it would perch on the rim of the tub while the gosling took its daily ablutions. Dr. Dillon Ripley has observed a hen-mother in the water with her foster brood of goslings.

Such a modification of normal patterns as that shown by the chick underscores the importance of social interaction as a determinant of behavior.—PETER H. KLOPFER, *Osborn Zoological Laboratory, Yale University, New Haven, Connecticut, July 8, 1955.*

Changes in English Sparrow population densities.—The English (or House) Sparrow (*Passer domesticus*) in general is associated with man and his works. When the English Sparrow was introduced and established in North America, the densest populations developed in the cities where human populations were densest. There, horses used for transportation supplied an abundance of waste grain for the sparrows to eat. With the replacement of horse-drawn transport by motor-transportation there was a decrease in the density of sparrow populations in the cities. (See especially Chapman, 1936. "Handbook of Birds of Eastern North America," p. 480, and Taverner, 1939. *Can. Field-Nat.*, 53:99.) Such a decrease is even now taking place in London (Fisher, 1954. "A History of Birds," p. 165).

A similar decrease in sparrow population has presumably taken place in Chicago. The magnitude of the decrease in the horse population is indicated by data from T. Carulin, writing in the Chicago Daily Tribune of May 26, 1955: In 1890 there were 101,566 horses brought into the city for sale; in 1931 there were 4,009 licensed horse-drawn vehicles; in 1955 it is estimated that there are 500 horses, including riding horses, in the stock yards and various stables, and only 52 licensed horse-drawn vehicles.

In the Chicago area there are now no English Sparrows in the heart of the city, where I have crossed part of the "Loop" twice a day for much of the past seven years, on my way to and from the Museum. There are sparrows on adjacent Michigan Avenue with its park, and there are sparrows on the city's south side, where the buildings are spaced out and there are trees and bits of gardens. But I've seen none in the downtown business section. Presumably they used to be there in abundance, feeding on the refuse from the horses that moved so much of the city's traffic at an earlier period.

It is not that there is no food available in the "Loop," for Domestic Pigeons (*Columba livia*) thrive there. About the La Salle Station there is often a flock of more than 100 pigeons, and probably several hundred of them live within two or three blocks of the station. These get their food in part from grain put out for them by bird-lovers; in part from cadging peanuts from passengers on the elevated train stations, and in part from foraging for scraps along the streets and amongst the garbage in the alleys. But evidently what is satisfactory for the pigeons is not for the sparrows.

In the Chicago area I know the sparrow populations are denser in the suburbs and outlying towns, but densest about the stock farms where hogs are being fed on special, ground-grain food. In the summer the sparrows spread out, some even visit the picnic areas on the Lake Michigan shores; in late summer the grain fields attract them in numbers. But in winter they withdraw to the human communities, to farm buildings, and most of all to farms where hogs are fed. At such hog-feeding places I've seen flocks of hundreds on a winter afternoon.

Some ecology textbooks correlated densities of House Sparrow populations at an earlier period directly with the density of human population, though they might have more pertinently correlated it with the density of the populations of the domestic horse. Fisher has already pointed out that the House Sparrow is not so much a parasite of man as an associate of domestic beasts, especially of horses, and Hausman (1946. "Field Book of Eastern Birds," p. 544) gives its habitat as the edge of cities, etc., especially where chaff, chicken feed, and similar foods are available.

The correlation of population densities is probably best put somewhat as follows: English Sparrow densities correlate directly with the densities of certain domestic animals, the species varying from time to time and from place to place. Earlier the densest sparrow populations were correlated with the densest populations of horses; presently they are correlated in the Chicago area with the densest hog populations, while in New Jersey they seem to be coincident with the densest domestic fowl populations. Perhaps in other areas, other correlations will emerge.—A. L. Rand, *Chicago Natural History Museum, Chicago 5, Illinois, May 5, 1955.*

Behavior of a Ring-necked Pheasant on a Prairie Chicken booming ground.—A thorough review of galliform hybrids was compiled by Peterle (1951. *Wilson Bull.*, 63:219), who pointed out the importance of similar habitat and behavior in hybridization. Lincoln (1950. *Wilson Bull.*, 62:210) reported a hybrid between the Ring-necked Pheasant (*Phasianus colchicus*) and Prairie Chicken (*Tympanuchus cupido*), but he offered no theories as to how it might have occurred. In May, 1954, I had occasion to observe how hybridization between these species might possibly occur in the field. The opportunity was afforded while I was in a blind, observing Prairie Chickens on a booming ground in Section 20, T23N, R5W, Missaukee County, Michigan. The surrounding area either is under cultivation or is grazed by sheep or cattle. There is a fairly dense pheasant population in the area.

I was in the blind on May 12 at 4:30 a.m. The weather was cloudy and foggy,

the temperature about 37°F. The Prairie Chickens began flying in at approximately 5:00 a.m., and immediately started booming and displaying. There were eight males and one female on the ground.

At 6:00 a.m. I heard a pheasant crow about one-quarter mile south of the blind. At 6:25 a.m. the pheasant was crowing 75 yards south of the blind. During the next five minutes, the pheasant walked into the midst of the displaying Prairie Chickens. Suddenly, it ran toward one of the males, which flew off about 50 yards. The pheasant flew after it immediately. The Prairie Chicken again took flight, with the pheasant still in pursuit. The pheasant alighted about one-quarter mile away, but the Prairie Chicken flew a few hundred yards farther. For a few minutes, the pheasant crowed in this area; then started slowly walking back toward the booming ground. At 6:45 a.m., the Prairie Chicken returned to the booming ground; a few minutes later the pheasant was back among the Prairie Chickens. The pheasant then ran after another male Prairie Chicken, which ran a short distance and then flew off. The pheasant flew after him for about 25 yards, alighted, and again returned to the booming ground.

Finally, a third Prairie Chicken was singled out, and the performance was repeated, after which the pheasant walked off about 30 yards, and at 7:00 a.m., flew toward the point from which it was originally heard.

One might theorize that the cock pheasant was merely intent on driving away possible rivals for his harem. On the other hand, he might have mistaken these relatively drab birds for female pheasants, after being attracted to the area by the dancing activity. In either case, if a receptive female had been "selected," the hen might possibly have submitted to copulation and *Phasianus-Tympanuchus* hybrids could have resulted.—Elsworth M. Harger, *Michigan Department of Conservation, The Heights, Michigan, June 3, 1955.*

Altitudinal records for Chimney Swifts.—Mr. Paul Farren, a former student of mine who pilots airplanes in attending to his work as a geophysicist, has given me records of Chimney Swifts (*Chaetura pelagica*) seen at high altitudes. The records are especially interesting because they are accompanied by precise meteorological data. The first of these records was so unusual in Mr. Farren's experience that he called to tell me about it. I asked him to keep me informed of other such observations; but it was more than three years before he reported to me again. At this time he wrote: "I average 3,500 miles per month air travel and frequently fly in the vicinity of 7,000 feet; so you can readily estimate how many miles I have traveled between sightings of these birds." Data on the three observations follow:

1. April 30, 1951, at 2:30 p.m., over Lufkin, Texas; altitude 7,300 feet; ground 325 feet above sea level. Two Chimney Swifts seen together, and then one about 10 miles farther on. A south to southeast wind blowing 25 to 30 m.p.h. at the ground and at the altitude of the plane; ground temperature 75°F.; a strong cold front about 150 to 200 miles to the west; light scattered clouds with bases at 4,000 feet and tops at 6,000 feet. The birds were flying above the clouds. Mr. Farren said: "I had never before seen birds at such a height."

2. May 18, 1954, at 4:30 p.m., over Refugio, Texas; altitude 7,000 feet; ground 80 feet above sea level. A single Chimney Swift "which struggled with considerable alarm and finally avoided my plane." Southeast wind 15 to 20 m.p.h. at the surface; variable winds 7 to 10 m.p.h. at the altitude of the plane; ground temperature 83°F.; squall line from the northwest about 50 miles distant, and a cold front coming in from the north, with rainy weather; an overcast of stratus clouds at 8,000 to 12,000 feet.

3. August 30, 1954, at 3:35 p.m., over Ames, Liberty County, Texas; altitude 6,500 feet; ground about 50 feet above sea level. One Chimney Swift "flying south in a frantic hurry." Temperature at the surface 102°F.; a cold front, preceded by a squall line, about 50 miles to the north. "Smooth, warm air, 25 miles south of a squall line of considerable turbulence."

All the circumstances of these three unusual observations suggest that, in each case, a cold front was beginning to drive a wedge of cold air under the warm air mass of southern Texas; that the warm air, in typical fashion, was riding high up the slope of the cold front; and that the Chimney Swifts were riding with the warm air. A little earlier, the warm air and the birds would have been at a lower altitude; a little later, the warm air would have cooled off, and the birds would have descended to more normal levels. Mr. Farren happened to see them at just the right moment.—GEORGE G. WILLIAMS, *The Rice Institute, Houston, Texas, June 20, 1955.*

Nesting of the Mountain Bluebird in Cleveland County, Oklahoma.—During the fall and winter of 1950 and the spring of 1951, large numbers of Mountain Bluebirds, *Sialia currucoides*, were seen in many counties of western, central, and east-central Oklahoma. They were first seen in early November and were seen continually until June. (November 3, 1950, is the earliest recorded date of which I am aware, and June 4, 1951, is the latest.) The species was regularly reported by both amateur and professional ornithologists, including M. Dale Arvey of the University of Oklahoma and Fred M. Baumgartner of Oklahoma A. and M. College. According to my observations they were generally more abundant than the Eastern Bluebird as late as early May, and in some areas occurred in flocks of several hundred birds.

Nice (1931. *Publ. Univ. Okla. Biol. Surv.*, 3[1]:145) declared the Mountain Bluebird to be a "common fall and winter visitant" in the "northeastern corner of Cimarron County" and a summer resident in that area. This is apparently a misstatement, since her earlier report (Nice and Nice, 1924. *Univ. Okla. Stud.*, no. 286:101) mentioned nesting in *northwestern* Cimarron County, and her source of information for the nesting record (Tate, 1925. *Proc. Okla. Acad. Sci.*, 4:32) stated that for two summers (1922, 1923) several Mountain Bluebirds nested in *northwestern* Cimarron County.

On April 21, 1951, Mr. and Mrs. Harold Cooksey located what they believed to be the nest of the Mountain Bluebird on the University of Oklahoma's South Campus (now a U. S. Navy Base) at Norman, Cleveland County, Oklahoma. They reported their discovery to me. They had seen a pair of birds going in and out of a hole in a small frame building, the *male* carrying nesting material. The building was unused at this time. The hole, about nine feet above the ground, was above the ceiling, so the nest could not be observed from the inside; however, it could be seen from the outside with the aid of a mirror and flashlight, and it could be touched by poking a finger through the hole in the building.

During almost daily observations throughout the next month, the pair was seen regularly in the immediately vicinity of the nest. They exhibited the typical nervous behavior of nesting birds, and were seen to copulate. On May 27, both birds were observed carrying food (insects) into the nest, and the female removed fecal sacs.

Two well-feathered young were visible in the nest on June 2. On June 4 at least one young was still in the nest. I did not visit the nest after this date.

To my knowledge, the species was not recorded east of the panhandle from June, 1951 to March, 1953, when it was seen in considerable numbers in Comanche County.

It was recorded by George M. Sutton and graduate students from the University of Oklahoma in Ellis, Harmon, Comanche, Caddo, and Canadian counties in 1954, and in Harper and Dewey counties in 1955. Certainly a large eastward emigration similar to that of 1950–51 has not recurred.

I am indebted to Mrs. John R. Whitaker, of Norman, for several of the observations at the nest site, and to George M. Sutton for the use of his field notes.— CARL D. RIGGS, *University of Oklahoma, Norman, Oklahoma, July 15, 1955.*

The Prothonotary and Kentucky warblers on Cozumel Island, Quintana Roo, Mexico.—Our observations of individuals of *Protonotaria citrea* on August 4, 5 and 9, and of one *Oporornis formosus* on August 5, 1954, on Cozumel Island, seem to constitute the earliest fall records of these species south of the United States.

Two immature males of the former species, taken on August 9, had a small amount of fat along the feather tracts, and the breast muscles appeared emaciated. The stomach of each contained only a small quantity of fruit pulp. An immature Kentucky Warbler had a stomach full of insects, but its breast muscles were extremely emaciated, suggesting a long flight on the previous night.

The fact that both of these species have also been taken in western Cuba seems to give further support to the hypothesis of a route through Florida and Cuba to Quintana Roo.

The foregoing observations and collections were made on the western coast of the island, and the specimens are in the collection of Dr. George M. Sutton at the University of Oklahoma.—ERNEST P. EDWARDS, *Box 611, Amherst, Virginia, and* RICHARD E. TASHIAN, *Department of Tropical Research, New York Zoological Society, New York 60, New York, July 27, 1955.*

An old nesting record for the Whooping Crane in North Dakota.—Because of the scarcity of nesting records of the Whooping Crane (*Grus americana*) it seems desirable to report an old North Dakota record for the species. This is a nest found by Mr. Frank Vejtasa in May, 1909, in Walsh County, North Dakota. I have found only two other recorded nestings for the state. One is given by Allen (1952. "The Whooping Crane," *Nat. Audubon Soc. Res. Rept.* no. 3) for Ina, Rollette County, June 3, 1871, one egg collected by Delos Hatch. Another is a rather indefinite record for Lakota, Nelson County, reported by Wood (1932. *Misc. Publ. Mus. Zool. Univ. Mich.* no. 10) who quotes Alfred Eastgate as saying they nested there "until 1908."

Mr. Vejtasa, who is a practising taxidermist and excellent nature-observer from Fairdale, North Dakota, gives me the following information about this record: On May 18, 1909, when he was 18 years of age, he flushed a pair of these cranes from a slough approximately nine miles south of Adams, Walsh County, North Dakota. This was a slough of about 30 acres containing cattails (*Typha latifolia*) and bullrush (*Scirpus* sp.). Waiting about two hours for the birds' return, he followed their movements and discovered a nest containing one egg. The nest was on a heap of rushes and cattails over about 10 inches of water. Returning to the nest 10 days later, on May 28, he found the egg still unhatched with the old birds very vehement about the intrusion. On June 15 the egg had hatched and the young bird was observed through field glasses with its parents. Returning about September 9, Mr. Vejtasa states that "I found the birds in the same slough. The young bird seemed as big as its parents,

only it was tan in color and had no bare skin on its face." He again studied the birds with field glasses as they waded about in the open part of the slough.

No birds returned to this area the following year or thereafter. Mr. Vejtasa reports that the last whoopers he saw were three birds seen in company with a flock of several hundred Sandhill Cranes (*Grus canadensis*) on May 2, 1912, about eight miles east of Edmore, Ramsey County. The birds were feeding in a stubble field and in a nearby slough.— EDMUND A. HIBBARD, *Windsor, North Dakota, July 18, 1955.*

Behavior of Purple Martins with displaced nests.—Purple Martins (*Progne subis*) have nested in community bird houses maintained on the campus of Kent State University for many years. In June of 1955, while nesting was in progress, a violent type of behavior was observed as the result of one of the martin houses being shifted in position. This one, having 16 compartments, is located on a pole set between two college buildings. On June 4 Mr. William Kline, one of the maintenance men on the campus, observed that the martin house had been turned during the previous night through an angle of 180°. The pole on which the house rests is a hollow pipe which can be revolved on its standard. That morning two male Purple Martins which had been pecked to death were found lying on the ground along with five or six smashed eggs. The birds, bleeding from being pecked in the head, and the eggs were still warm when found. The house was then returned to its original position. On June 15 it was discovered that the house had been turned again during the previous night, this time through an angle of about 90°. Two newly-hatched nestlings, blind and naked, and six smashed eggs were found on the ground. The person or persons responsible for turning the house and the reasons for doing so were not known, but probably it was done as a campus prank. Apparently the Purple Martins became confused when the nests were displaced so that they entered the wrong compartments which led to the killing of two adult males on one occasion, the destruction of two nestlings in the other, and the destruction of half a dozen eggs each time.— RALPH W. DEXTER, *Department of Biology, Kent State University, Kent, Ohio, July 29, 1955.*

American Egret feeding with cattle.—Rice (1954. *Auk*, 71:472–3) discussed the phenomenon of symbiotic feeding of Snowy Egrets (*Leucophoyx thula*) with cattle and mentioned that he had no knowledge of a similar association by American Egrets (*Casmerodius albus*).

On May 22, 1955, Thomas R. Hellier, Jr., and I were observing a flock of at least 100 Snowy Egrets feeding with cattle in a pasture 12½ miles west of Vero Beach, Indian River Co., Florida. No Cattle Egrets (*Bubulcus ibis*) were observed, although the locality is only about 35 miles from Okeechobee, where they are numerous. I identified (verified by Hellier) a single American Egret standing in front of, and facing, the head of a cow. No other egrets were associated with this cow. The bird appeared more skittish than the Snowy Egrets, and, unlike them, seemed quite wary of the cow. However, I definitely observed it to capture at least one insect which had been flushed by the cow. Shortly afterward the bird flew to another cow (also unaccompanied by other egrets) where it again assumed a similar waiting stance at the animal's head, although it was not seen to feed again. It is likely that the American Egret had been attracted to the pasture by the large numbers of Snowy Egrets, and that it would not have directly associated with the cattle in the absence of the other birds.— DAVID K. CALDWELL, *Department of Biology, University of Florida, Gainesville, Florida, September 5, 1955.*

Breeding of Cassin's Sparrow in central Oklahoma.—The Cassin's Sparrow (*Aimophila cassinii*) is considered a rare bird in most of Oklahoma. Nice (1931. *Publ. Univ. Okla. Biol. Survey*, 3 [1]:185) reported its breeding in Cimarron County at the western end of the panhandle and in Jackson and Harmon counties in the southwestern corner of the state. She mentions that McCarthy and Clark, in 1860, collected eggs at Adalene Creek, Corral Creek, and Rabbit Ear Creek, but states that "most of these creeks unfortunately have changed names, making the location of the collections rather indefinite;" however, she believes that probably these sites were in what is now the westernmost column of counties in the state. Howell (*Proc. Okla. Acad. Sci.*, 29, 1948:36–37) reported a small colony of breeding Cassin's Sparrows in Woods County, just east of the panhandle.

This sparrow has been recorded only once from central Oklahoma. On November 21, 1952, Jean W. Graber (1953. *Wilson Bull.*, 65:208) collected an immature female in postjuvenal molt near Noble, Cleveland County. The occurrence of such a bird in that locality seemed puzzling at the time.

On May 5, 1955, in the moderately overgrazed, open prairie two miles north of Norman, Cleveland County, I encountered three singing males along a fence row and among abandoned oil well equipment in an area of approximately two acres. They sang either from perches or, more often, during short display flights. I collected one in full adult plumage (U. O. M. Z. no. 2068); its testes were much enlarged. These Cassin's Sparrows probably had arrived at the locality some time after April 28, on which day I had spent at least an hour at this spot without detecting a bird of this species. On May 6, Margaret M. Nice, Donald H. Baepler and I observed one individual there and heard two others along fence rows, about one-eighth and one-fourth miles distant. On May 12, I recorded four singing birds, even more widely distributed over the prairie, always along fences. A male which George M. Sutton and I watched for at least 30 minutes on May 13 sang repeatedly during display flights and remained within a maximum of 100 yards of a silent Cassin's Sparrow, most probably a female, the first we had encountered.

Thus it appeared that a breeding population of this bird was indeed present here, at least 100 miles east of its previously-known breeding range. However, no proof of nesting was to be obtained until after several weeks had passed. From May 9 until about May 25, 1955, Oklahoma experienced unusual amounts of rainfall; in the central part of the state up to four inches fell each day on May 16, 18, and 19. Perhaps coincidentally, May 17 was the last day of the month on which I heard the song of this sparrow; still, while it may have entered into a period of little or no song at about this time, it seems likely to me that the abundance of rainfall retarded the nesting cycle of this species whose breeding center in the state is in the markedly drier western portions.

My visits to the area became less frequent during June, and not until June 23 did I detect the bird again. On June 30 I observed a solitary pair within 200 yards of the original location. For an hour I watched them from a minimum distance of about 50 yards; both remained most of the time along an approximately 100-yard stretch of fence. The male sang from posts and wire, never during flight, with silent periods of up to 20 minutes; its mate spent much of her time on the ground near the fence, occasionally flying for brief visits to a growth of small wild plums about 75 yards to the south. No young birds were in evidence, nor did either adult appear to be visiting a nest. Within half an hour after moving into my car, using it as a "blind," I twice saw the male, with food in its beak, fly directly from one fence post to a particular small

area of ground nearby; during the next half hour the female also visited this spot twice with food, though she arrived by a much more devious route. The nest held five nearly-fledged young; it was on the ground, well concealed among weed one to two feet high, primarily ragweed (*Ambrosia psilostachya*), about 20 feet north of the fence, and in the firelane 35 feet in width paralleling the fence. The young showed clearly the distinct dark striping on the breast; one was collected (U. O. M. Z. no. 2161).

The presence in the fall of 1952 of an immature Cassin's Sparrow (mentioned above) provides evidence that this bird probably has nested in central Oklahoma for a minimum of four years. Considering the facts that in the three intervening years a considerable amount of time has been spent in the field in the vicinity of Norman by ornithologists from the University of Oklahoma and by local enthusiasts, and that prior to this year no Cassin's Sparrows have been encountered during the breeding season, it seems certain that this bird breeds here only in widely-scattered, small populations.—JOHN C. JOHNSON, JR., *Department of Zoology, University of Oklahoma, Norman, Oklahoma, July 29, 1955.*

Wilson's Petrel in southern Ontario.—Hurricane "Connie" passed south of Buffalo, New York, at approximately 6:00 p.m. on August 13, 1955, bringing gale-force winds and torrential rains to the eastern end of Lake Erie. The following morning Eric W. Bastin, George Meyers and Glenn Meyers, all of Hamilton, Ontario, searched the north shore of Lake Erie at likely points in the affected area, hoping to see unusual pelagic birds.

At Grabell Point, near Long Beach, Ontario, the body of a Wilson's Petrel (*Oceanites oceanicus oceanicus*) was picked up by Glenn Meyers. Lying just above high-water mark, it was water-soaked but otherwise in good condition, no decomposition being apparent. Identification was confirmed shortly afterwards by Dr. Harold Axtell of The Buffalo Museum of Science, who joined the party later. The petrel was given to The Royal Ontario Museum of Zoology, Toronto, Ontario. The only previous record for the species in Ontario occurred in the year 1897, at Gull Lake in the Muskoka District.—ERIC W. BASTIN, *43 Inglewood Drive, Hamilton, Ontario, Canada, September 2, 1955.*

Prairie Warbler breeding in Texas.—Breeding of the Prairie Warbler (*Dendroica discolor*) in east Texas has been suspected for some time, for some of these birds remain here several weeks after the main migration has ended. Bent (1953. *U. S. Nat. Mus. Bull.* 203:436) does not list this warbler as breeding in Texas. I saw and heard singing males of this species in the late spring and early summer in 1952, 1953 and 1954 in three localities in Smith County, Texas, but found only two abandoned nests and three immature birds during that time. These observations were witnessed by my wife and some of the members of the Tyler Audubon Society.

In 1955 my observations were begun 12 miles south of Tyler in an abandoned field of about 15 acres which contained second-growth sweet gum (*Liquidamber*), hickories (*Carya* sp.) and oaks (*Quercus* sp.). Nearby were shortleaf pines (*Pinus* sp.), various shrubs and a stand of grass 15 inches tall. On visiting this area on April 17, I discovered that some of the Prairie Warblers had already arrived, and during the following weeks I observed from four to six singing males in the vicinity of the old field at all times. On May 30, I observed a female gathering nesting material and flying into a 25-foot sweetgum, but I did not locate the almost-completed nest until

June 5. The nest was situated about 15 feet above the ground and was well hidden in the dense foliage close to the trunk of the tree. Both male and female were seen in the nesting tree on the latter date and other males were heard singing nearby. My observations were discontinued until June 22, at which time I carefully observed the nest but found no nesting or feeding activities being carried on. Both birds were seen near the nest and the male sang only occasionally. On June 26, there was no activity around the nest but adult Prairie Warblers were seen gathering insects in a field of partridge peas (*Cassia*) and flying into a large oak on the edge of the old field. This feeding was repeated several times, but a high wind and the thick foliage in the tree prevented my locating the young.

On July 4, I abandoned my watch at the nest and moved some 200 yards away. After hiding about 30 minutes, I saw a pair of Prairie Warblers gathering insects from the partridge peas and flying in different directions. Following the female to a small sweetgum, I saw her feed a fledgling in juvenile plumage, its tail about one-half inch long. I observed this pair, mostly the female, feed the young bird 12 times in about 35 minutes. In the meantime, the fledgling changed locations three times. Although active for a young bird, it could barely fly and ran on the ground part of the distance between bushes.

On July 10, I observed a pair of adults feeding two young within 50 feet of where I had seen them on July 4. This was probably the same family for the young were more mature, but were being fed by the adults most of the time. Also seen in the area at this time was a juvenile which was feeding itself and which showed some pale yellow on its underparts. The adults were now beginning to show signs of molting and only three songs were heard in a three-hour period, these being rather weak as compared to the songs heard earlier in the spring.

I wish to thank Mr. Horace H. Jeter for suggestions and encouragement which enabled me to locate the nest and young of the Prairie Warbler.—O. C. SHEFFIELD, *817 West Houston, Tyler, Texas, September 7, 1955.*

Rose-throated Becard nesting in the Chiricahua Mountains, Arizona.—On July 7, 1954, the writers, during a hurried excursion in the Chiricahua National Monument, Arizona, were fortunate in discovering a female Rose-throated Becard (*Platypsaris aglaiae*). The bird was first seen in a tall pine beside the road, about halfway between Monument headquarters and Massai Point, where it was following and scolding a female Cooper's Hawk (*Accipiter cooperii*), which we had frightened off a nearby nest. At first the becard was carrying food, but either ate or dropped it after a time. After watching the bird for more than half an hour, we went back to headquarters and immediately returned to the area with Mr. Robert Barrel, the park naturalist. Although the Cooper's Hawk was again flushed from its nest, the female becard was not found. Shortly after our return, however, we discovered two becard fledglings which had extremely short tails but otherwise were quite recognizable.

No attempt was made to find the nest, but the area appeared favorable. A creek bed runs beside the road on the opposite side from that on which the becards were observed; hence sycamores and other stream-bank trees are present. This habitat is reminiscent of that in which the nests described by Phillips (1949. *Condor*, 51:137-139) were located. Even though the nest was not found, the presence of the very young birds definitely establishes this breeding record, which is apparently the third reported nesting of this species in the United States.

The Rose-throated Becard has been considered rare in the United States, but recently it has been observed several times. Until 1945, the only authentic record of this species for the United States was that of an adult male taken by Price (1888. *Auk*, 5: 425) in the Huachuca Mountains of Arizona. In 1945, Davis (*Auk*, 62:316-317) reported the presence of summer-resident becards in Cameron and Hidalgo counties, Texas, and in 1949, Phillips (*loc. cit.*) described six active nests, which he located during the summers of 1947 and 1948 in the Santa Cruz River drainage of central southern Arizona. The Arizona birds were identified by Phillips as *Platypsaris aglaiae richmondi*. The Texas birds, however, were assigned to *P. a. gravis* by Sutton (1949. *Auk*, 66:365-366), who collected three specimens in Hidalgo County. Those observed in the Chiricahuas may be presumed to be *richmondi*.—Robert H. Gibbs, Jr., *Department of Conservation, and* Sarah Preble Gibbs, *Department of Zoology, Cornell University, Ithaca, New York, July 17, 1955.*

Goshawk captures American Crow.—On July 23, 1955, the writer observed what appears to be an unusual instance of predation by an adult Goshawk (*Accipiter gentilis*) on an American Crow (*Corvus brachyrhynchos*). At their call of alarm, my attention was focused on a flock of approximately 10 crows roosting in the tops of some large hemlocks in a heavily-wooded area in the Upper Peninsula of Michigan, near Shingleton. In a moment a Goshawk was noted swiftly diving upon the crows from a southwesterly azimuth, which, in midafternoon, was directly in line with the sun. Although the flock quickly dispersed, the goshawk singled out one bird and gave pursuit. For a few short moments this crow desperately attempted maximum evasive action; however, despite its valiant flight the hawk easily matched each maneuver and the crow was quickly driven to ground. At this point both victim and raptor were lost from view due to the presence of low but dense vegetation. The remaining flock meanwhile circled overhead, frenziedly cawing and repeatedly diving to within a few feet of the hawk, which was settled on the ground. However, after several minutes of such action the crows departed silently.

During the short period of time which elapsed before it reappeared to view, the Goshawk presumably was consuming a portion of the kill. When next seen it was laboring in flight with the crow clutched tightly to its body. An eight-foot woven wire fence with a two-foot overhang obstructed its path at the end of about 200 feet of flight; however, this was cleared easily at the last moment and the hawk continued into the heavy timber beyond. Careful search did not again reveal its presence in the immediate area.

Although Goshawks are not commonly abundant in the Upper Peninsula of Michigan during summer, Wood (1951. *Misc. Publ. Mus. Zool. Univ. Mich.*, no. 75:103–105) has recorded several recent instances of Goshawks nesting in this locality. Due to its large size, agility, and speed of flight, Goshawk predation on game animals, particularly the Ruffed Grouse (*Bonasa umbellus*), has been commonly noted. There is evidence suggesting that the Ruffed Grouse may serve as a staple food item wherever these species coexist. This instance of predation on crows may be related to the relative scarcity of both the Ruffed Grouse and Sharp-tailed Grouse (*Pedioecetes phasianellus*) at the present time due to their cyclic low populations. Perhaps when natural prey species are reduced in abundance Goshawks resort to feeding on normally less preferred prey which are commonly available in large numbers.—Louis J. Verme, *Michigan Department of Conservation, Shingleton, Michigan, September 9, 1955.*

ORNITHOLOGICAL NEWS

We are pleased to announce that Drs. George A. Bartholomew, William A. Lunk, Kenneth C. Parkes, and Raymond A. Paynter, Jr., have indicated their willingness to serve on the newly-constituted Editorial Advisory Board for *The Wilson Bulletin*. Dr. Lunk has served the Society as Illustrations Editor for the past three years.

Excellent opportunity, including financial aid, for field studies in ornithology during the summer of 1956 is provided at the University of Michigan Biological Station located at Cheboygan, Michigan. An introductory course, an advanced course and graduate student research, under the direction of Dr. Olin Sewall Pettingill, Jr., and facilities for independent research by mature ornithologists, will be offered.

Courses and similar research opportunities in various other aspects of field biology also will be offered under the leadership of distinguished faculty members in each of these fields.

Through the generosity of the National Science Foundation, financial aid will be available to about 20 applicants, irrespective of field of interest.

For further information, address Biological Station, Unversity of Michigan, Ann Arbor, Michigan.

The American Museum of Natural History announces that annual awards will be made from the Frank M. Chapman Memorial Fund during the month of April. This fund was established to provide financial aid to individuals conducting research in any branch of ornithology. The awards usually are made to younger scientists, in particular graduate students, but there are no hard and fast restrictions.

Applications should be received before March 31 of the year in question. Each applicant should state clearly the nature of the proposed research and give a careful estimate of the financial requirements of the project. Letters of recommendation should, wherever possible, be included. All correspondence should be directed to the Chairman, Chapman Memorial Fund Committee, Department of Birds, American Museum of Natural History, New York 24, New York.

SOME THOUGHTS CONCERNING THE INTRODUCTION OF EXOTIC GAME BIRDS

(A Contribution from the Wilson Ornithological Society Conservation Committee)

Intentionally or unintentionally, man has been transporting plants and animals hither and yon about the world for centuries. Many of these transplants have failed; a few have succeeded, some with disastrous results. Of the many introductions of exotic game birds which have been made in the United States since the first planting of Hungarian partridges in New Jersey about 1790, three, the Ring-necked Pheasant (*Phasianus colchicus*), Hungarian Partridge (*Perdix perdix*), and the Chukar (*Alectoris graeca*), have been successful.

Interest in the introduction of exotic game birds—and mammals—has increased greatly during the past decade. A part of this has been due to the interest sportsmen acquired in the new species which they had seen during overseas duty with the armed forces. Possibly of equal importance has been the year by year increase in the number of hunters without a corresponding increase in the amount of game or in areas open to hunting. Also, many areas have been so altered by man that the native species no longer exist in sufficient numbers to provide hunting. The forces generated by the disgruntled hunter and the game administrator seeking to satisfy the demand for more game have resulted, among other things, in the recent reopening or enlarging of game farms and in an increased interest in new game species.

In 1949 the International Association of Game, Fish and Conservation Commissioners appointed a committee to study the problem of game introductions. This committee found that the U.S. Fish and Wildlife Service had already begun work in this field, having employed Dr. Gardner Bump to investigate the desirability and adaptability of certain exotic game birds, particularly species which would be successful in the arid and semi-arid southwest. Although the costs of this activity were being paid out of Pittman-Robertson administrative funds, apparently some state administrators were not aware of the program.

With the federal program already in operation, it is not at all surprising that the committee concluded in March, 1950: "1. That investigations and restrictions on the introduction of exotic animals into the United States and Canada should extend to all species of wild birds, mammals and fish, including non-game species. 2. That some central agency should undertake the task of determining, insofar as possible, the desirability or undesirability of exotic animals proposed for introduction, and of effecting the introduction of those game species which investigations indicate to be desirable and which will fill an existing need. 3. That the United States Fish and Wildlife Service is the most logical agency to act in this capacity, and that the eight per cent administrative funds available to that agency out of federal aid in wildlife restoration appropriations is the most logical and equitable source for financing the project. 4. That the project should involve not less than two full-time qualified technicians, nor more than $50,000. annual expenditures. 5. That the legal restrictions upon the importation and/or introduction of species known or believed to be undesirable should be strengthened in every way possible, particularly within the state and provincial codes." (The fortieth conv. of the Intern. Assoc. of Game, Fish and Conserv. Comm., Sept., 1950, pp. 23-24). The committee also concluded that the existing program of the Fish and Wildlife Service should be expanded and that the introduction of mammals and fish should be investigated.

The following year the committee observed that four species of birds held promise of "filling voids in extensive ranges in our Southwest". These were the Chukar, the Seesee, (*Ammoperdix griseogularis*), the Black Partridge (*Francolinus francolinus*) and the Oriental Sand Grouse (*Pterocles*). The Black Grouse (*Lyrurus tetrix*) and Capercaillie (*Tetrao urogallus*) were already being tested in Wisconsin. The committee observed that the Fish and Wildlife Service was financing the program from their regular appropriations and that interested states should see that these appropriations were not killed by "people who misunderstand the intent and purpose of this activity." (The forty-first Conv. of the Intern. Assoc. of Game Fish and Conserv. Comm., Sept., 1951, p. 25).

In addition to the federal program referred to above, several states have embarked upon their own programs. These activities are founded upon the thesis that many habitats have been so changed by man that the native species can no longer maintain themselves in sufficient numbers to provide hunting. "Competing interests and the cost of reversing this trend are such that only a fraction of these lands can be restored to reasonable productivity in the foreseeable future. There are other coverts which never were fully occupied by native game birds or mammals possessing the characteristics requisite to survival in the face of today's intensive hunting pressure. For these, new, adaptable species possessing a high hunting resistance must be found or such areas will continue to provide hunting opportunities far below their productive potential." (Bump, G. 1951. *Trans. No. Amer. Wildl. Conf.*, 16: 317–18). These states are experimenting with various species of pheasants and exotic quail or attempting to create new forms through breeding.

A tremendous number and variety of exotic birds and mammals have been, and are still being, liberated by individuals and clubs. Some idea of the extent of this activity is obtained when we read that by 1940 at least 18 species of game mammals and 21 game birds had been imported into New York State alone, nearly all of them entirely or in part by individuals or clubs (Bump, G. 1941. *Trans. No. Amer. Wildl. Conf.*, 5: 409-420). The writer's experience has been that the tempo of this type of activity by individuals and clubs has been steadily increasing during the past 10 years.

There are a number of dangers inherent in the introduction of exotics. According to H. W. Levi (1952. *Sci. Monthly*, 74 [6]:315) these are: ". . . those of bringing in diseases, of hybridization with animals already present, and of ecological maladaption, including the crowding out of native species." The writer is doubtful that adequate study can be made in the federal program to properly guard against these dangers; he is certain that these dangers receive little if any attention from most states, clubs or individuals.

The successful introduction of an exotic will produce changes in the ecology of the region in which the transplanted species thrives. In spite of apparent belief to the contrary by many administrators and some biologists, the idea that all of these changes can be predicted at present is ridiculous. Man has, however, made tremendous changes in the ecology of nearly every part of the world. He has the desire and the capability to continue making these changes at an ever increasing rate. It may not be presumptuous to point out, however, that although the position taken by the "ecological purist" may be indefensible, the fauna and flora of America is the heritage of us all not just the hunter. It is barely possible that something may be gained and little will be lost by informing, or even consulting, other segments of the population concerning the direction and goals of the coming planned ecology.

In the writer's opinion, the state is the key to the control of the introduction of

exotics. Exotics are unlikely to be introduced into a region by federal agencies unless the states involved express a desire for them. Some states lack adequate legislation to control the introduction of exotics by clubs and individuals. Even with authority though, it is often difficult for a state administrator to prohibit an importation and some state administrators apparently feel that it is expedient, at times, to encourage the importation of exotics. Decisions in matters of this kind are usually made at the administrative level; biologists often become informed of the situation when they are ordered to make the importation. A few states appear to have abandoned hope of being able to manage their native game birds and are searching for an exotic that can satisfy the demands of the hunter without management. In this respect, it appears possible that it is one thing to introduce Chukars into the southwest but quite another to introduce an Eurasian quail into the southeast where, presumably, it is supposed to multiply in those ". . . areas (which) have been so altered by man that the native species no longer exist in sufficient numbers to provide hunting" but avoid those areas still occupied by the native bobwhite.

The importation of exotic game birds—and mammals—will continue. The successful introduction of these exotics will alter the ecology of the regions involved, whether for better or for worse will depend upon one's point of view. The writer suggests, however, that adequate study and control of these importations is woefully lacking at state and local levels. Expediency does not appear to be an adequate substitute for study in guarding against the importation of diseases and the possible deleterious effects of hybridization (particularly when subspecies of indigenous forms are imported from other states) or the possibilities of ecological maladaption. It is furthermore respectfully suggested that, when importations of exotics are being contemplated, the desires and advice of biologists and conservation organizations other than those directly concerned with hunting might well be given consideration by both federal and state agencies.—Robert A. Pierce.

THE WILSON ORNITHOLOGICAL SOCIETY LIBRARY

The following gifts have been recently received. From:

Aaron M. Bagg—3 reprints
Andrew J. Berger—3 reprints
William H. Burt—8 reprints
Stephen W. Eaton—8 reprints
Karl W. Haller—10 books
Stuart Houston—3 reprints
T. H. Hubbell—1 pamphlet
David W. Johnston—4 reprints
Alden H. Miller—28 magazines
Margaret M. Nice—7 reprints
Frank A. Pitelka—2 books
Eustace H. Poor—3 reprints, 29 magazines
L. L. Snyder—16 bulletins
Wendell Taber—8 bound volumes of magazines
Josselyn Van Tyne—12 reprints
Dale A. Zimmerman—1 reprint

ORNITHOLOGICAL LITERATURE

NORTH AMERICAN BIRDS OF PREY. By Alexander Sprunt, Jr. Based upon and supplementary to "The Hawks of North America," by John Bichard May. Published under the sponsorship of the National Audubon Society by Harper & Brothers. New York. 1955: 6½ × 9½ in., 227 pp., 47 plates (43 in color) by Allan Brooks and others. $5.00.

Serious ornithologists should be grateful that popular interest in birds has increased to the point that American publishers now feel that it is worth their while to publish an average of one new bird book a week. Many fine ornithological works have been produced in recent years, and some of these have been outstanding financial successes. An unfortunate corollary to this spate of bird books lies in the temptation, to which publishers submit all too often, to jump on the band wagon with an ill-conceived, hastily produced volume, on the assumption that *anything* about birds will sell these days.

Neither the publisher nor the National Audubon Society has gained stature by the publication of the latest of Alexander Sprunt's scissors-and-paste jobs (see J. C. Dickinson's review of "Florida Bird Life," *Wilson Bull.*, 67, 1955:146–147). Once more a work widely regarded as a classic of its kind, in this case May's "Hawks of North America," published in 1935, has been replaced by a patchwork volume which is an insult to the original book.

To take up the illustrations first: all but one (European Merlin and Kestrel) of the original Brooks color plates have been reprinted, but the reproduction is mediocre, about one-third of the plates in my copy being badly out of register. Since the present volume, unlike the 1935 edition, includes the owls, colored illustrations of owls have been rounded up from a variety of sources to be reused. Four artists (Brooks, Fuertes, Horsfall and Weber) are represented among the owl plates. Although all but two species of the diurnal birds of prey are figured in color, only 10 of the 18 included species of owls are so favored.

The text, following a foreword by Roger Tory Peterson and a general introduction by the author, is organized into 10 chapters; one for the owls and one each for nine more-or-less natural subdivisions of the Falconiformes, as originally used by May. Each chapter is introduced by a short general discussion, largely paraphrased from May. The individual species and subspecies accounts begin with the English and scientific names, with a translation of the latter. Then comes a list of "local names," usually an abridgment of May's similar list. A paragraph entitled "Recognition" follows: this is again usually a paraphrased and abridged version of May's "Description" (a more accurate term, since field marks are seldom pointed out as such). No particular purpose seems to have been achieved by thus changing the original wording, and the abridgment has sometimes been detrimental; thus, nowhere in Sprunt's text is the dusky head-color of immature Turkey Vultures mentioned.

Next comes a paragraph entitled "Nesting." This is an addition to the original May material. The descriptions of nests and eggs appear to be adapted from those of Bent (1937–38. *U.S. Nat. Mus. Bull.* 167, 170), although no source is specified except for occasional direct quotations. A summary of the range follows; the useful little maps which appeared in May's book are not reprinted.

After these introductory paragraphs, the general discussion of the species (entitled "History") is presented. It is the avowed intention of the author to shift May's strong emphasis on food habits toward a more general description of the ecology of each

hawk or owl. The very detailed food analyses of the 1935 book are thus either briefly summarized or largely omitted. Much of the remainder of the text is a rehash of Bent and other standard authorities; little or no attempt seems to have been made to utilize the abundant recent literature on the birds of prey. Other than the author's own publications, only two works subsequent to Bent (1937-1938) are listed in the bibliography: Arnold on the Golden Eagle (*U.S. Fish and Wildlife Serv. Circ. no. 27, 1954*) and Koford on the California Condor (*Nat. Audubon Soc. Research Rept. no. 4, 1953*). There is a strong subjective vein running through the book, the author's own field experiences receiving a rather disproportionate amount of space considering the small number of pages available for each species. This is carried to an extreme in the case of the Rough-legged Hawk, a species for which much authentic life history material is available. One of the three pages allotted to the "history" of this species is devoted to a fantastic hearsay story of a supposed nesting of the Rough-legged Hawk at Lake Okeechobee, Florida, a story which Sprunt admits he has already told in print on two previous occasions!

The most inexcusable aspect of this book is the obvious haste and carelessness with which it was thrown together. The classification and nomenclature are roughly those of the A.O.U. Check-list as amended through 1954, but with dozens of errors. One species and eight subspecies accepted by the A.O.U. prior to 1954 are omitted, while five subspecies no longer admitted to the Check-list are included by Sprunt. A half-hearted attempt was apparently made to conform to purely nomenclatorial changes instituted since the 1931 Check-list, but the amount of care given to this task may be judged by the fact that the two subspecies of Elf Owl are assigned to separate generic names. The paragraphs on *Otus trichopsis* and *Otus flammeolus* appear in the middle of the list of subspecies of *Otus asio*. Typographical errors abound, especially in scientific names: *cathartes* for *Cathartes*, *fuertsi* for *fuertesi* (twice), *Haliaetos* (twice) and *Haliaetus* for *Haliaeetus*, *Asiootus* for *Asio otus*, etc. Baja California is variously rendered as Lower California, lower California, and Baja, California (the latter twice on one page). Two subspecies of *Strix occidentalis* are transferred to *S. varia*. Little attention is paid to gender within scientific names; thus, we have *Aegolius acadicus acadicus* but *Aegolius acadica brooksi* and *Aegolius funerea magnus*. The statement is made that "the Dwarf Horned Owl is not included here since it inhabits the southern part of Lower California and is not to be seen in this country," yet full treatment is allotted to one full species and three additional subspecies whose ranges are also confined to Baja California. The paragraph from which the above statement is quoted also contains a misspelled subspecific name and a verbless sentence. The list is interminable.

The book closes with a convenient summary, by Kenneth D. Morrison, of state and provincial laws relating to bird protection. There is no index.

Most book reviews end with some such sentence as "The minor errors cited above in no way detract from the general high quality of the work." Such a statement cannot be made about "North American Birds of Prey," especially when we have May's classic "Hawks of North America" as a standard of comparison. Fortunate, indeed, are those of us who bought the 1935 edition at the fantastically low original price of $1.25. Today's buyer of bird books would be well advised to ignore the Sprunt book completely, and apply the $5.00 price toward the eventual purchase of a set of Bent's "Life Histories."—KENNETH C. PARKES.

THE BIRDS OF MASSACHUSETTS. AN ANNOTATED AND REVISED CHECK LIST. By Ludlow Griscom and Dorothy E. Snyder. Peabody Museum of Salem, Inc., 1955: 5½ × 8 in., xiii + 295 pp., 3 maps. $3.75.

A full quarter-century has elapsed since the publication (1925–1929) of Forbush's three-volume classic, "Birds of Massachusetts and Other New England States." This period coincides with that during which "the virtuoso of field identification," Ludlow Griscom, has been associated with the Museum of Comparative Zoology at Harvard, first as Research Curator and subsequently as Research Ornithologist. As a consequence of Mr. Griscom's residence in Massachusetts since 1927, the science and the sport of recording birds in that State have achieved peaks of popularity and brilliant technique equaled in few similar areas. This has produced a great increase, quantitative and qualitative, in information about Massachusetts birds.

In the volume under review, Mr. Griscom and his eminently capable collaborator, Miss Snyder, have given us "an annotated and revised check list" which is abundantly justified by the timeliness of its appearance, the soundness of its approach, and the importance of the new material it contains (including not only the post-Forbush data, but also the hitherto-unpublished resources of various manuscripts, journals, and collections).

The student of avian faunistics who is concerned with the problem of what constitutes a valid record will find the case for the "severe school" presented ably (and at emphatic length) in this book. The long and active history of field ornithology in Massachusetts has provided the authors with an extraordinary abundance of material, ranging from data of the early 19th century to the latest spate of sight-reports. The sheer wealth of this material has permitted the authors the luxury of using the most severely strict criteria in assembling a state list based upon absolutely valid data. Just as this book is timely in meeting a need, so also does it fulfill the authors' avowed intent: ". . . to record adequately, and prove by documentation wherever possible, the true status of the forms found in Massachusetts."

This check list, then, has been compiled according to the following rules: "For every bird officially on the state list we require a specimen, a banding record by a reputable ornithologist, or a recognizable photograph on file and readily available for examination. All other forms have been placed in the Hypothetical List, without regard to the observer."

Griscom and Snyder give the number of authentic Massachusetts birds as 430 (384 species, 46 additional subspecies). The Hypothetical List numbers 51 forms; of these, there are 21 birds of which it is indicated that their identification is considered to have been correct. This latter device seems a realistic method of treating those birds which have been accurately "sight-recorded" beyond reasonable doubt, but for which no specimens, photographs, or banding records exist.

The long and active history of Massachusetts ornithology gives this book a further advantage: dimension and perspective in the changing status of various species. Thus, we are shown not only the major swings in avian populations, but also the short-term fluctuations over chronological periods which, in some cases, involve more than a century.

It is difficult to fault this book in any serious respect. There are the inevitable trivial errata. There will be raised eyebrows (particularly among Wilson Society members) over this isolated clause: ". . . since the technique of nest finding is a lost art,"—a significant statement, indicating the fact that the emphasis in Massachusetts is upon listing and recording, rather than on observing and studying. The emphasis upon such abundantly-worked areas of Massachusetts as Essex County, the Boston region, the

Cape Cod area, and the Connecticut and Housatonic valleys will serve to point the fact that, even in the 1950's and in the limited extent of the Bay State, there are considerable areas which are, ornithologically, virtual *terrae incognitae*.

Great potentialities for ornithological research, in all the various aspects of that broad science, are available in Massachusetts. (For example, recent banding studies of fall migrants, conducted by John V. Dennis on Nantucket Island, are most promising). Whatever the coming years may produce of ornithological significance in Massachusetts, future historians of the birds of that State can build with confidence on the solid facts which this book provides.— Aaron M. Bagg.

Prairie Ducks. A Study of Behavior, Ecology and Management. By Lyle K. Sowls. The Stackpole Company, Harrisburg, Pennsylvania, and The Wildlife Management Institute, Washington, D.C., 1955:193 pp. $4.75.

Frequently we are brought to the feeling that wildlife management is based more on the managerial practices of laymen than on science. It is such splendid works as "Prairie Ducks" that help immeasurably to make wildlife research a science of maturity and dignity. This book is a must for any serious student of waterfowl management or research, and it is equally indispensable to the layman who wishes to understand something of the problems and programs of state and federal waterfowl management.

This treatise is based on an immense amount of field observation, experimentation and study by the author, supplemented by the work of a number of able colleagues, mostly at the Delta Wildlife Research Station, Delta, Manitoba. Most of the data were obtained at the Delta marshes between the years 1946 and 1950; but much stimulation, help, and constructive criticism came from outstanding authorities in the field of waterfowl research and management.

This book gives evidence of having been developed in a scholarly and scientific atmosphere. It sets a high standard hitherto unattained in waterfowl research, and adds much to both information and techniques. The approach was an intensive study of individual birds, with particular reference to behavior, habits and ecology at different periods, and in different areas, on the summer range. Also considered are such problems as homing instincts, nesting and renesting, hen and brood behavior, molt, territoriality, mortality, and problems associated with fall migration.

In the main the book is well written, although some chapters seem to represent better writing than others. On a few minor points one might wish for a little additional treatment, or regret an omission of what appears to be an important point. For example, one of the greatest mortality factors is drought in the prairies. However, a discussion of this seems to have been largely omitted in this book. I believe the brief summary dealing with the food habits of predators would have been even clearer and more convincing had the standard volumetric percentages been given to supplement the information included. The brief treatment of crippling loss in the last chapter is likely to leave the inexperienced worker or sportsman with the feeling that this waste will be eliminated if only a retriever is added. While this recommendation is very worthwhile it will by no means answer the problem. A campaign to get shooters to desist from shooting so much out of range and to refrain from flock shooting would probably do much more good. These are indeed minor points as compared to the outstanding treatment of the subject as a whole.

While it is strictly scientific, the book is written in a popular style for public consumption; and all scientific names, and nearly all technical jargon, are omitted from the body of the text and are reserved for a short appendix in the back. A particularly

helpful feature that makes the book stand out is the succinct summary of salient points recorded following each of the 11 chapters.

The most attractive features of the book, which give understanding, feeling and atmosphere of prairie waterfowl habitat, are the numerous and excellent line or black and white drawings by Albert Hochbaum and the beautiful colored frontispiece which is one of Peter Scott's best waterfowl paintings. The numerous photographs, figures, charts, and tables are well done, and add much to the finished product. The book is outstanding in its attractiveness, design, readability and accuracy of subject matter treated. Certainly the author, the artists, the publisher and the sponsor are all to be congratulated for a superior job which adds an effective milepost to the uncertain road of waterfowl conservation in America. This book sets a high standard for future workers to follow.— CLARENCE COTTAM.

THE ORNITHOGEOGRAPHY OF THE YUCATÁN PENINSULA. By Raymond A. Paynter, Jr. Peabody Museum of Natural History, Yale University, Bulletin 9, 1955: 10¼ × 7¼ in., 1–347 pp., 2 maps, 4 pl. $9.50.

With the growth of interest in the avifauna of México and in the migration routes of North American birds, an authoritative work on the bird life of the Yucatán Peninsula is a welcome addition to the literature.

An introductory chapter of Dr. Paynter's book considers the methods used and the physical and biotic setting of the area under discussion. There follow 283 pages devoted to an annotated list of the 429 species (487 forms) reported from Campeche, Yucatán, Quintana Roo, and their offshore islands. In each account one is oriented as to the general range of the species; this is followed by a list of specimens recorded, data on habitat distribution, and remarks. When available, weights and data on breeding condition are included. Of greatest theoretical interest is the 21-page discussion of composition, distribution and origin of the avifauna. A bibliography and an index complete the book.

Of the 429 species recorded, 285 (330 forms) breed in the area or are presumed to do so, 115 winter, 26 are transient, and three are considered accidental. Excluding marine birds and vultures, the breeding avifauna of the peninsula proper consists of 262 species, while 90 species breed on the islands; eight of the latter are not found on the peninsula.

Since the Yucatán Peninsula is somewhat isolated from the rest of México and lacks topographic diversity, the problems of speciation are different from those of the remainder of the country. For example, among the land birds one group reflects the effects of decreasing humidity which are indicated by the increasingly xeric appearance of the vegetation found in proceeding from south to north on the peninsula. This rain forest element is represented by 105 species on the mainland, but by only five on the islands, whereas corresponding totals for the other major group, species characteristic of drier habitats, are 112 and 55. Seventeen species of the rain forest have developed subspecies on the peninsula, and these differentiates are paler and, as a rule, smaller than their representatives in the more luxuriant forests to the south. No such trend is found in the peninsular subspecies of the birds of drier habitats, which are restricted principally to the northern part of the peninsula. The importance of the role of population structure is indicated by the observation that the species which form races on the peninsula are those which exhibit similar variability elsewhere in their ranges.

From the standpoint of its origin, the breeding avifauna is broken down into three categories, a widely-ranging element, a group of six species which probably arrived

from the West Indies directly, and eight endemic species. Since the major portion of the peninsula is young geologically and physiographic barriers are absent, differentiation above the level of subspecies probably has occurred there only a very few times. Hence most of the endemics must have originated elsewhere.

The faunistic analyses are handled in a thorough and convincing manner, and the taxonomy used is progressive. For example, all the wood thrushes are united in *Catharus*, the genus *Chamaethlypis* (Gray-crowned Yellowthroat) is merged with *Geothlypis*, and a monotypic genus (*Agriocharis*) is no longer retained for the Ocellated Turkey. Further study of the latter case may prove desirable.

Production of the book is generally excellent, although a few misprints appear among the generic names in the faunal analysis section. Even though the price seems excessively high, students of zoogeography in general and Mexican birds in particular will find this work an invaluable addition to their working libraries.—Keith L. Dixon.

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